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OVERHEAD COSTS AND RATES IN THE U.S. DEFENSE INDUSTRIAL BASE

Volume I

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This document investigates and analyzes the elements of overhead cost structures for major weapon systems. The investigation of overhead costs and rates was based on Department of Commerce data from 1961-1977 for 72 major U.S. industries as defined by their 4-digit SIC (Standard Industrial Classification) number. For the specific purpose of this analysis, 21 of the 72 industries were examined closely. These 21 industries make up a major part of the defense industrial base and include both the major weapon builders and their supplier industries.

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Based on the collected data, overhead costs were defined as all costs including profit other than direct labor and direct material costs incurred by a corporation in doing business. The overhead rate was defined as overhead costs divided by direct labor costs.

Although overhead as it is defined in this report is a simplification of how overhead is determined within the corporate sector, the definitions of overhead rates and costs which are used are consistent with the concepts of variable and fixed costs as they are normally defined by economic theory. The purpose of this project was to establish analytical benchmarks and techniques for the military Program Manager rather than to establish rigidly defined cost accounting structures.

The conclusions to be drawn from the analysis were that overhead costs have increased rapidly during the last ten years. Furthermore, as a percent of sales, the cost of production line labor has decreased steadily since 1960. Similarly, total labor costs as a percent of sales have decreased since the 1960s even when adjusted for fringe benefits. The data also shows that, contrary to general economic theory, the number of production line (direct) and non production line (indirect) workers has remained relatively constant for the period under review. This would seem to indicate that the size of the total labor force employed in an industry either cannot or has not been manipulated to gain economies of scale. How this has happened is still unclear. However, the results indicate that the rapid increase in the cost of military equipment is due to a number of economic and policy factors, with overhead costs appearing to be the major component of cost increases.

To round out the analysis, a series of discussions are presented on the findings of this project and the implications for (1) the defense acquisition process and (2) economic policy formulation in the United States. In addition, two appendices present data and analyses on fringe benefit costs and energy costs in selected industries.

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EXECUTIVE SUMMARY

Prologue

The purpose of this report is to explore the structure of overhead costs and rates within U.S. industry in order to provide the military acquisition manager with a better understanding of the organization and dynamics of the industrial structure on which he relies. As with many other analyses, this project was concerned with providing some better explanation of the reasons for the apparently rapid increase in the cost of military equipment. Unlike other analyses, however, we sought in this project to develop insights into the "market basket of goods" that eventually becomes a major weapon system. Our frame of reference here was our own prior work on the shipbuilding industry which suggested strongly that the shipyard cost of building a combatant could be readily explained by recourse to general economic data. This same analysis, however, showed that we were then unable to explain the total cost of a ship system primarily because we did not then have any basic data on those other industries whose output is integrated into what eventually becomes a modern sea-going combatant vessel.

Among its many objectives, this current analysis sought to develop that data in order to determine whether the generic technique developed in the ship cost study had broader applicability. Based on the case example cited in Chapter III of this report, we believe that it does. The central conclusion that may be drawn from this case analysis is the need when projecting the costs of a weapon system to disaggregate the costs of the system into its principal components and then, based on these subsidiary analyses, determine the general behavior of the various industrial sectors that participate in the ultimate configuration of the product. The data base we have developed has been organized to accomplish this disaggregation process.

What we are accepting here is the truism which states that the reason for the rapid increase in the cost of military equipment is its inherent complexity. Our data would tend to reinforce this conclusion while, at the same time, suggesting that the cost to the military of the output of a specific industry has probably deviated very little from the generalized cost of civilian goods produced by that sector.

The central problem for the military manager is (1) the fact that many U.S. industries do not operate anywhere near their capacity, (2) that many defense industries operate well below an economically efficient level of operations, and (3) that there has been a quantum jump since the early 1960s in the complexity of the weapon systems now being acquired by the military. In this regard, it might do well to suggest that the complexity is not due to the desire of the military to purchase science fiction devices, gold plated products, or other unnecessary amenities. Rather, because of the predicted nature of modern warfare and the resource shortages faced by most free nations, it is essential to maximize the combat capability of any major weapon system acquired by the military departments. This requires an array of highly sophisticated technology-pushing, high cost componentry purchased from industries whose cost trends may deviate substantially from those of the more basic defense industries: aircraft, shipbuilding, and armored vehicles. Because of this and the other two factors noted above, the prices and costs of various weapon systems may have increased more rapidly than most observers are able to accept psychologically. Psychological discomfort to the contrary, the ultimate price of a major weapon system may not be substantially higher than that suggested by a generalized analysis of the cost structures of those industries which contribute

goods and services to the final product.

From the perspective of the military planner, this raises the issue of "affordability". Here our analysis would suggest that the primary trade-off, if economic efficiency is the goal, should not be stated in terms of the units of output, e.g., 10 versus 6 aircraft per month, but rather in terms of the various systems integrated into the overall system. The added expense of short production runs is also one of the main cost drivers in many modern weapon systems. Recognizing this should lead towards a more defined view of "affordability".

From a purely economic point of view, the U.S. can afford virtually any quantity or quality of military equipment that it desires provided only that it is willing to sacrifice one collective good for another. If it elects not to make the sacrifice, it must then make choices with respect to the quantity and quality of the military equipment that it can purchase. Although the quality/quantity dichotomy gets expressed in dollars, it is only secondarily an economic issue. First and foremost, there is affordability, a strategic and military decision involving such disparate choices as the structure of the industrial base that supports our military acquisition program; the general economic health of the nation; when and how we would elect to fight a war; and other factors above and beyond the scope of this analysis.

Fundamentally, what this current analysis does is provide insights into the costs of weapon systems <u>once the decision has been made to purchase them</u>. It suggests ways of analyzing the costs of these systems, techniques for controlling the cost of these systems if strategic and doctrinal

considerations will allow this action, and rudimentary techniques for measuring the relative efficiency of an industry or a firm.

Here it must also be underscored that the analyses and analytical techniques set forth in this report are exploratory in scope and content. They now appear to provide tools and techniques for the Program Manager and his military superior to effectively integrate industry and influence the military in the decision making process. More work needs to be done here, however, before the approach can be validated and placed into general use. Nonetheless, we believe that this approach should be accepted as a supplement to on-going CS^2 (7000.2) procedures in order to develop working techniques for more appropriately describing the trade-offs in quantity, quality and configuration called for by an affordability analysis.

Non-Military Considerations

A significant portion of the effort in this project was directed at the collection and analysis of micro-economic data on a broad segment of U.S. industry. Narrowly stated, our initial concern was with the analysis of the trends in overhead costs and overhead rates, over time and in different industries. In order to do this, however, we had to define the term "overhead" in a way which would allow us to make a legitimate assessment of the meaning of the data available to us. Because overhead, as we define it, includes all costs including profit, other than production line labor and direct material, it was necessary to further disaggregate the data. This we have done by looking at the cost trends for non-production line labor, fringe benefits and related costs, and (outside our formal data base) such factors as profits, interest and other costs such as the recoupment of depreciation expenses. In a sense, then, overhead costs as we have defined them are all of those items included in the businessman's informal but inclusive view of the "cost of doing business".

These costs have increased rapidly during the last ten years. Moreover, our data supports the contention that these costs have not only increased these past ten years but that, absent any significant change in the organization of our economy, will continue to do so in the foreseeable future.

At the same time, our data appears to contradict some generally held views of the state and organization of our economy by showing, for example, that:

- As a percent of sales, the cost of production line labor has decreased reasonably steadily since 1960.

- Similarly, total labor costs as a percent of sales have decreased since the 1960s even when adjusted for fringe benefits.

In more conventional mac economic terms, this data would suggest that the productivity of American labor in those industries analyzed has increased since 1961 absent a substantial and major decrease in the efficiency with which this labor is employed.

A more in-depth analysis, however, would suggest that this last outcome is not salutary. It most likely reflects the under-utilization of key elements of our economy and the overwhelming and rapidly increasing costs otherwise attributable to a labor force.

In the same vein, our data shows that the relationship between the number of production line workers and the number of non-production line workers has remained relatively constant over time. This outcome was unexpected and especially so for those industries in which employment has fallen since the 1960s. We had assumed that the relationship was not constant; that in keeping with general economic theory, the number of non-production line workers would decrease more rapidly than production line workers when employment within an industry was drawn down. Conversely, we assumed that during periods of growth, the number of production line workers would increase more rapidly than the number of non-production line workers.

This has not, in general, occurred since the early 1960s. Instead, the proportional relationship between the two segments of the labor force has remained relatively constant over time, except for the Vietnam period. In more recent years, the trend, if anything, has favored the non-production line worker. This, then, would suggest one of two possible outcomes:

- that the size of the total labor force employed within an industry either cannot or has not been manipulated to gain economies of scale.

- that these economies were, in fact, possible but that government policy and regulation since 1970/71 has increased the amount of paperwork in the private sector such that it is no longer possible in many segments of the U.S. economy to gain labor-desired economies of scale.

If our analysis is correct, it may be safe to assume that it may no longer be possible in many industries to increase the output of the production line worker rapidly enough to offset the increased "cost of doing business" in order to constrain price increases within our economy. This is not to suggest that the productivity of the production line worker cannot be improved through efficiency-seeking measures or by substituting capital for labor. Rather, it would suggest that further price increases in our economy can be constrained only if it becomes possible to increase industrial output without a proportionate increase in the number of employees whose activities are not <u>directly</u> related to the output of a good or service. For as long as non-production labor is or must be treated as a variable cost, i.e., varying directly with the number

of production line personnel, the potential for labor-derived economies of scale appears to be limited. The force of this factor alone would act to forestall any significant increase in the overall productivity of the total labor force employed in an industry or by a firm.

In our opinion, treating all labor as homogenous in assessing the potential for productivity gains and other improvements in industrial efficiency obscures the nature of the decision to be made by management and the implication for the general economy of decisions of this type. In this regard, we sought to establish a data base which, with proper refinements, might better illustrate the policy trade-offs available to the manager.

It is interesting to note that our data would suggest that the conventional wisdom on the substitution of capital for labor still obtains, i.e., that those firms which continue to invest wisely tend to improve their relative competitive position. However, it also seems evident that one of the more important causes of the apparent lack of worker productivity in our economy is our apparent inability since the late 1960s to (1) utilize our industrial base at anywhere near appropriate capacity, and (2) our lack of willingness or inability (which one is not clear) to control labor related overhead costs. That is to say, to search for labor related economies of scale on the downside of the business cycle. By failing to do this, we appear to have created an economic structure where it is difficult, if not indeed impossible, to gain price constraining improvements in productivity on the production line. This last conclusion appears to be supported by the data collected and analyzed during this project. It is the basis for our earlier statement that it may no longer be possible, without

significant economic and industrial reform, to increase the output of a production line worker rapidly enough to offset the increased "cost of doing business".

Here there is an apparent logical discontinuity in our data base which must be underscored. Were it possible to increase the rates of utilization for key segments of our economy, labor costs as a percent of sales would increase. As throughput was increased with all other costs, other than material, held relatively constant, the apparent return to labor would increase, i.e., the labor intensity of the product as measured by labor's share of its price would increase. This would happen because fixed overhead costs would be spread over more units of output thus decreasing overhead costs per unit of output. The effect of this action would be to leave more of the final price to be allocated to material and labor. Thus, our data which shows labor costs decreasing as a percent of sales can, if not properly interpreted, lead to inappropriate conclusions if compared to macro-economic data on the phenomena. That the cost of labor as a percent of sales has decreased is fairly strong evidence of substantial capacity-related inefficiencies in our economy. In other words, the issue of worker productivity, as measured by pounds of output or other similar measures, is but one side of the coin of the productivity problem.

Equally relevant are the managerial considerations of corporate organization and structure. These are analytical elements which do not fit neatly into a data matrix and are thus generally ignored. Because of this, it is impossible to draw any conclusions on management's determined input into the efficient use of labor other than a review of the statistics on capital investment. Here there is evidence that capital investments have, with the possible

exception of the Vietnam War, remained relatively constant over time and have not, in the context of this discussion, been fully responsive to changes in the structure of the modern, heavily regulated American corporation. Once again, our data is as yet inconclusive here. However, one interpretation of our data drawn from our prior work on the shipbuilding industry would provide strong support for the contention that the cost and effect of government regulations has reached that level where the costly impact of government regulation can no longer be overcome solely by intensified capital investments. Furthermore, it can be concluded that the entire structure of American industry will have to be modified to accomplish the goal of productivity improvements as a technique for modifying price increases and/or inflationary pressures. This and a broad range of other issues are discussed in the analysis that follows.

Organization of the Report

The report that follows is divided into Two Volumes. Volume One is the main report -- executive summary and four chapters. Volume Two contains the appendices.

Volume One:

Chapters One and Two present the technical analysis with which this project is basically concerned. In Chapter One, overhead is defined and discussed from both an economic and corporate perspective. Data on the trends in overhead costs and rates for twenty-one industries central to the defense acquisition process is presented along with data on specific aspects of the resource allocation process within the selected samples of industries. A partial analysis of the relevance of this data to an interpretation of cost and other trends in the aerospace and electronics industry is presented in Chapter Two.

Chapter Three is an analysis of data on the costs of selected elements of a naval shipbuilding program. The trend in employment levels, overhead rates and product cost for a key subsystem is related to the total cost of a naval combatant. Because of its sensitivity, the data has been disguised.

Chapter Four presents a series of discussions on the findings of this project and its implications for (1) the defense acquisition process and (2) economic policy formulation in the United States.

Volume Two:

Appendix A presents data on the fringe benefit costs in selected industries as a percentage of sales and as a percent of overhead. The data base covers the period from 1971 through 1977.

Appendix B presents data on energy costs in selected industries as a percentage of sales and as a percent of overhead. The data base covers the period from 1971 through 1977.

Exhibits are presented at the end of the relevant chapter or appendice in which they are referred.

It must be noted here that when this project was undertaken, complete data sets, upon which our analysis is based, were available up through 1977. Data for 1978 will become available in late 1980, as will some estimates for 1979. This data will be incorporated into the data base as it becomes available.

CHAPTER I: INRODUCTION TO THE PROBLEM

A. General Overview

The purpose of this analysis is to develop additional insight into the weapons acquisition process by investigating and analyzing the behavior of overhead costs and rates with especial emphasis on actual, absolute overhead costs. Our analysis is directed at determining:

- What the dollars devoted to overhead "buy" by way of goods and services.
- Which portion of the overhead dollar, if any, is under the control of management.
- Within the total bundle of dollars spent, the trend line for specific expenditures; i.e., the rate of growth (positive or negative) in specific cost categories and the implications of these various trend lines.
- Whether it is possible to determine a level and/or "quality" of expenditures which can be related to such factors as efficiency and productivity; i.e., whether it is possible to identify patterns of expenditures which promote innovation, productivity and efficiency within an industry or specific components of that industry.

The need for the analysis is two-fold. First, when acquiring major systems, the Department of Defense is required to pay its "fair share" of the overhead costs of the vendors with whom it does business. In order to do this, the relevant

buying agency determines an overhead rate for the contractor which is estimated to be adequate enough to guarantee the absorption into the final cost of an equitable share of a contractor's non-production line costs. The overhead costs and rates are initially estimated by both the contractor and the contracting officer. At the end of a contract, a final rate for payment purposes is then determined from an audit of the contractor's books and adjusting payments are made. Despite the initial estimate and the final reconciliation of the absolute number of overhead dollars to be paid on a contract, very little is known by the government about the behavior of the specific costs which make up the overhead account; whether management is controlling them; whether these costs are "reasonable"; and the external factors, such as general price trends and inter- and intra-industry competition that may influence these costs. Because overhead costs may now be the largest single cost element for which the government becomes contractually responsible, it would appear worthwhile to explore their behavior.

The overhead rates used to determine how much of a firm's overhead will be absorbed by the DOD acquisition process have been increasing steadily since the early 1970s (see Exhibit II). In other words, in both relative and absolute terms the DOD acquisition dollar appears to be buying less and less of the physical, tangible output of its contractor base as measured by the input of production line labor and material. If this is so, it is probable that an ever increasing portion of the acquisition dollar is now being spent instead to <u>maintain</u> actual or latent corporate capability. By itself, this outcome is neither good nor bad. However, by driving unit costs up, an outcome such as this may serve to limit the quantity and quality

of the military equipment that we are now able to purchase and deploy. This is the affordability issue noted earlier. Indeed, it now appears evident that the costs of acquiring weapon systems have increased at a far faster pace than has otherwise been expected by cost analysts within the Department of Defense. Further, there appears to be a growing discontinuity between the rates of increases in the cost of civilian vis-a-vis military goods. Our analyses suggest that a major portion of this discontinuity occurs in the overhead as opposed to the direct labor or direct material cost categories.

In all fairness, it must be noted that overhead costs are increasing throughout all our manufacturing industries. Increased overhead costs thus are not simply a result of the defense acquisition process but are more broadly symptomatic of major changes in the ways in which American industry has organized the manufacturing and distribution process and, indeed, the management process itself. More will be said on this subject later in this report.

B. Prologue on Accounting Methods

We began our investigation of overhead costs and rates, by collecting Department of Commerce data from 1961 through 1977 for 72 major U.S. industries as defined by their SIC (Standard Industrial Classification) number. For the most part, the data collection effort was directed at industries defined by a four digit SIC code number although analyses were also made of a number of larger but less specific industrial groupings, i.e., industries defined by three digit SIC codes.

The raw data which we collected contained no specific information on either overhead costs or rates. Therefore, we have defined both these terms. These definitions are explained in detail in the following section C.

Although our definitions of overhead costs and rates are consistent with the concepts of variable and fixed costs, as these are normally defined by economic theory, it is a simplification of how overhead is determined within the corporate sector. We are aware that industry often calculates overhead rates against a base comprised of either (1) the total of the sum of direct material and direct labor costs, or (2) a somewhat differently defined "cost of goods sold" measurement. Because of the expanded cost base, the use of these two alternative measures results in overhead rates that are significantly lower arithmetically than the numbers used in this analysis. However, these alternate measures will not, in fact, decrease or otherwise reduce the absolute level of the costs that must be absorbed in the manufacture of a product. Since we were concerned more with <u>establishing analytical benchmarks</u> than with establishing rigidly defined cost accounting structures,

and since there is no one accounting definition of the term overhead, our definition is more than adequate for our current purposes. Further, our definition is reasonably consistent with the overhead pool as it is defined in most major systems acquisition contracts. Since this work is concerned with costs per se and not cost accounting techniques. Therefore, the selection of an arithmetic base for absorbing overhead costs was not as significant as developing techniques that might allow us to differentiate between those funds dedicated to the manufacture of a product and those funds dedicated to maintaining overall corporate capabilities.

Here it should be noted that we are aware that using production line wages, as calculated by the Department of Commerce data, tends to understate overhead costs because, for example, most accounting systems oriented to the defense acquisition process treat payments for time not worked as charges to overhead. Our data includes these payments as a direct charge and thus understates both the charges to the overhead account and the rate that is used to relate these charges to the direct labor base. However, this relative understatement of overhead costs and rates is not analytically significant. Where required, relatively simple adjustments can be made to our data to account for these factors.

We are similarly aware that many company specific accounting systems include depreciation expense, energy expense and certain other production line costs in the "direct cost" category. Because our task is not to analyze how or even <u>why</u> companies classify costs into certain cost categories but rather to analyze the behavior of these costs, we have elected to treat them separately where we felt that this level of detail would clarify our analysis.

We did so because we recognized that classifying costs into various categories such as direct and overhead is a relatively mechanical process once specific costs have been disaggregated and identified. Depending upon one's view of the manufacturing process, costs or even portions of costs may be placed into one accounting category or another depending basically upon management's view of how and why a specific cost was incurred, and management's desire to monitor or otherwise control certain categories of costs. Company history is important here in that a properly organized accounting system provides management with a tool with which it can extrapolate the future from past trends. However, most accounting systems are tailored to the needs of a specific company and may not reflect the more general industrial and economic trends which are the focus of this analysis.

It was for this reason that we developed an analytical technique that was independent of the more narrowly defined accounting and planning requirements of an individual firm. Because it is an objective measure of the actual cost structure of an industry, it can later be used as a benchmark for analyzing the specific behavior of a firm within an industry.

C. Overhead Costs and Overhead Rates Defined

1. Overhead Costs

For the purposes of this analysis, we have defined costs as consisting of all the costs other than direct labor and direct material costs incurred by a corporation in doing business.

- Overhead Costs = Sales - (Direct Labor Costs + Direct Material Costs)

Our definition of overhead costs, then, includes depreciation expense, fringe and other salary related payments, non-production line labor, rentals, etc. In other words, all other costs not otherwise classified as direct (production line) labor and direct material. In classical economic theory, these costs are regarded as fixed since they are not expected to vary with sales. In this context, only direct labor and direct material costs are considered to be variable or, in more practical terms, vary directly with units of output.

In reality, of course, some overhead costs are neither fixed nor variable. That is, they increase or decrease as sales increase or decrease, albeit disproportionately. This gives rise to alternative definitions that recognize three classes of costs: variable, fixed, and either semi-variable or semi-fixed. More important than the definition, however, is the assumption that there is a medley of costs which are <u>not fully variable</u> and that controlling these costs can generate profit providing economies of scale. If all costs were variable, for example, it would be impossible to gain economies of scale.

Some of the costs categorized by us as overhead are oftentimes classified by analysts as indirect, i.e., those costs which are not readily identified nor visibly traced to the output of a specific good or service. As we stated previously, in more traditional economic theory, these costs are generally regarded as "fixed" and are treated as such in our analysis. Costs normally included in this category include such items as leasehold or machinery rentals, long term financial charges, depreciation expenses for plant and equipment, and specific elements of the non-production line labor force payroll, e.g., executive salaries, bonuses and fringe benefits.

However, some costs included in our definition of overhead, although regarded as indirect by most analysts and hence classified as fixed, may in fact vary with sales. In some instances, these costs are readily identified with a specific product as in the instance of sustaining engineering staff. In other instances, although they vary directly with sales, these costs are not so easily attributed to a product or service. The more relevant factor, analytically, however, is not the identification of these costs with a specific output but the fact that they are lumped into the overhead pool as a fixed cost either by management or by a contracting officer when establishing prices or, in the instance of the government, the payments to be made to a contractor.

Some of the costs in the latter category include the salaries of non-executive, non-production line workers such as engineers, the fringe benefits for all categories of employees, salaries paid for time not worked and a number of other costs which, because of widely-used accounting conventions, are regarded as part of the indirect or overhead cost pool.

At issue, then, is the fact that some of those costs regarded as fixed are either variable or semi-variable. Equally at issue is the fact that there is no firm understanding of how these costs should be classified. The specific meaning of the terms "overhead", "indirect costs" and other terms connoting fixed or semi-variable costs are somewhat clouded in practice.

In our opinion, this lack of precision in defining costs leads to serious misunderstandings about the structure of U.S. industry and how it reacts to all manner and form of change. Further, this imprecision leads to a basic misunderstanding of the purpose served by overhead costs, and most specifically that portion of the overhead pool that is not dedicated to the output of a specific good or service.

2. Overhead Rate

For the purpose of this examination, we defined the overhead rate as a function of direct labor costs. That is to say, we set the overhead rate equal to overhead costs divided by direct labor costs.

- $\text{Overhead Rate} = \frac{\text{Overhead Costs}}{\text{Direct Labor Costs}}$

Our choice of direct labor costs as the basis for determining overhead rates rests on the fact that the direct labor cost category is the base normally used to establish prospective and retrospective overhead rates in government contracts. Because of our central concern with the acquisition process, we were concerned with the establishment of rates that are comparable to those found in on-going government acquisition programs.

D. Organization of the Data Base

The data on the 72 U.S. industries which we have collected for this analysis has been organized around the concept of a statistically average production line worker and the resources needed to maintain him. This analytical methodology is in keeping with previous work we have completed on the shipbuilding industry. (See Building Naval Vessels: A Handbook of Shipyard Costs, Edward M. Kaitz & Associates, Inc., 1979.)

For example, in the study just cited, we determined that a statistically average production line worker in the U.S. shipbuilding industry in 1976 absorbed $44,667 in resources. This figure is equivalent to industry sales ($5.896 billion) divided by the number of production line workers (132,000).

This $44,667 figure was subsequently broken down into a number of components

- the worker's wages; $12,265.
- the cost of material "used" by him; $19,773.
- the overhead costs attributable to him; $12,639.

Overhead costs were further broken down into those costs attributable to

- non-production line labor
- energy

- fringe benefits
- residual and as yet undefined "other" costs.

In addition, data on capital investments and other financial factors was collected and analyzed.

For each of the 72 industries included in our sample for this analysis, data was collected and analyzed from 1961 through 1977, the last year for which basic data is now available from the Department of Commerce. Given this data, we now have the ability to analyze and measure the allocation of resources over time within an industry and between industries. As of the moment, the data reflects the "average" level of performance within an industry and is unable to specify the deviations around this average. This would require collecting company specific data, a task that was not undertaken because of resource limitations. This is planned for a later phase of this project.

The decision to array the data around the concept of a statistically average production line worker was based on the desire to gain insight into the micro-economic structure of an industry; that is to say, those variables which are factored into the managerial decision-making process. This data is, of course, significantly different in scope and content than the data used in macro-economic analyses which generally deal with economic aggregates and, for the most part, with data which is external to the firm. Because of the differences in perspective, our data must be interpreted differently.

Further, our data, as it is arrayed, is not normative in the sense that no <u>direct</u> conclusion on worker productivity, industrial efficiency and other factors can be drawn from

the data. Rather, the data describes a series of outcomes in an industry, e.g., a ship requiring 1,000 man years of production line labor would have cost $44,667,000 in 1976 versus $25,302,000 in 1970. The data describes the differences in factor input between 1970 and 1976, or any other time period, e.g., in production line labor costs, material costs, overhead, and other costs, thus providing a comparison of the economic inputs into the shipbuilding or other industrial process over time. Despite the descriptive nature of the data, we do believe that reliable judgments on economic efficiency can be made from the data, particularly if company specific data is available. In addition, the data can be used to extrapolate the future cost of various goods and services with greater precision than macro-economic data inasmuch as the trends in at least four categories of cost can be modelled separately. The data bank we have developed is especially useful in estimating the cost of major weapons systems whose final assembly represents the output of a broad range of diverse industries since intra-industry trends can be specifically identified and factored into the equation.

It should also be noted here that the data, by showing employment trends, does provide significant insights into the effect on an industry which operates below capacity. There appears to be a general relationship between

- decreasing levels of employment within an industry and increasing overhead rates.

- increasing levels of employment within an industry and stable overhead rates.

- increasing levels of employment within an industry and capital investments.

- capital investments, workers wages, and the rate of increase in the resources used in an industry.

- inflation and overhead.

Because of the scarcity of data at the four digit SIC code level on industry utilization rates, we have used employment levels in an industry as an approximate surrogate for capacity utilization rates. It must be mentioned here that the full implications of the data base have not yet been fully explored. In working with the data, we have become aware of a number of critical economic and industrial relationships that need to be examined further for the insights they can provide into the economics of the defense industries per se and those of our industrial base in general. Many of these will be discussed at length in the report and the commentary on the report that follows.

E. The Data Base: Outcomes

Given our key goal which is to better explain the cost dynamics of the defense acquisition process, we elected to concentrate our investigation on the 21 four digit Standard Industrial Classification code industries listed in Exhibit I. The basis for this selection was twofold: we wanted first to include those industries such as aircraft, guided missiles, and shipbuilding that are obvious components of the defense industry; second, we wanted to include in our base those industries that are "feeder" industries to the defense industries. The list of industries, however, is neither exclusive nor all-inclusive.

As a first step, we derived the overhead rate for the 21 industries included in our sample as shown in Exhibit II. A note of caution is necessary here. The overhead rate shown in this exhibit can depart substantially from overhead rates negotiated with specific companies, due to varying company or industry interpretations of 1) the term "direct labor" as it is used in government contracts and 2) the utilization rates for the personnel placed in this category. In this regard, it should be noted that government contracting procedures have a life of their own in that they require the defense industrial community to adopt cost allocation procedures which may or may not be representative of the actual industrial dynamics within various industries. Since our data is descriptive only, it avoids this problem. In other words, the data does in fact describe the long term economic structure of the industry apart from the specific behavior induced either by government contracting procedures or by company accounting conventions.

As is shown by Exhibit II, overhead rates vary from industry to industry, albeit over a wider spectrum than was initially anticipated. The shipbuilding industry (SIC 3731), with 1977 overhead rates of approximately 111% of production line labor costs, is at the low end of the spectrum. The computer industry (SIC 3573), with 1977 overhead rates equivalent to 658% of production line labor costs, is at the other extreme. By themselves, these figures and the trends that they represent are neither "good nor bad" but are simply representative of the production line labor intensity of the various industries analyzed. The lower the rate, as in shipbuilding, the more production line labor intensive is the industry. The higher the rate, the more likely it is that the industry is either capital or material intensive. See Exhibits III, IV, V, VI.

More important than production line labor intensity, however, is the general trend in overhead rates. From 1961 through 1977 overhead costs increased steadily across most industries with the highest rates of increase in overhead rates recorded by the computer industry (164 percent) followed by the semiconductor industry (112 percent). The increase in rates is reasonably general across all industries, ranging for the most part between 30 percent to 50 percent. Some industries, however, have shown remarkably consistent overhead rates for the seventeen years under review. This appears to be related to the intensity of capital investments within the industry.

Of perhaps more importance than the increases themselves is the fact that the rate of increase, where increases have occurred, accelerated since the early 1970s. At the more basic level, there are three specific areas in which costs have increased rapidly:

- Energy costs
- Supplementary wage costs, i.e., social security taxes and other labor related fringe benefits
- Corporate profits

Each of these costs eventually shows up in the overhead category. Because of the continuing internal adjustments that must be made by industry to accommodate to these increased costs, we now regard them as evidence of major structural changes within U.S. industry.

Put another way, it appears safe to say that the market basket of goods bought by the ultimate consumer now contains a different array of labor costs, profit factors, and energy and other costs, than it did from the early 1960s to mid 1970s. For 19 of the 21 industries surveyed, direct labor costs now account for less of the ultimate sales dollar of output. See Exhibit VII. Where this is the proven result of the substitution of capital for labor, the conventional wisdom on overhead costs and rates would suggest that this is salutary since it would suggest an increase in worker productivity. Our interpretation of the data does not, however, support a conclusion of this type. Instead, our analysis would suggest that most industries have been unable to offset with productivity gains a rapid runup in the costs of factors of production other than labor. Industries have thus been forced to increase their prices at a far faster pace than the trend in labor costs alone would require.

Since our sample is biased towards defense industries, and since these industries have shrunk in size since 1968, some increase in overhead rates should be expected in those

industries. However, there are a number of unexplained anomalies even in the case of the defense industries. Although the general trend in overhead rates in these industries appears to be the result of reduced levels of output, the rates of increase appear to be greater than otherwise anticipated. This suggests that economic factors other than capacity utilization rates are at work, although the importance of this single factor should not be played down.

Confirming evidence of the influence of the force of these other economic factors can be found, in our opinion, in a review of those industries not dominated by the weapons acquisition process. The general trend in overhead costs in these strictly civilian industries is also strongly upwards. To suggest that both civilian and defense industries are suffering from significantly lower levels of capacity utilization than obtained in the 1960s would appear to be incorrect. The data on employment trends simply does not support the thesis. In the shipbuilding industry, for example, both employment levels and overhead rates are up, a contradiction in terms of the conventional wisdom of industrial behavior.

Similarly, we do not believe that it is safe to assume that the increased overhead rates are the result, solely, or even primarily, of the increased substitution of capital for labor. First, were this true, the increases in productivity gained by this substitution would have served to moderate at least somewhat the inflationary pressures which have been created in our economy. Further, as our data shows, many U.S. industries have not invested heavily in new plant and equipment. See Exhibit VIII. Among those industries that have failed to invest are the defense industries, most specifically the aerospace industry. For all intents

and purposes, the industry has remained labor-intensive. Despite this, its overhead costs and rates have increased disproportionately.

In this respect, it is noteworthy that indirect labor costs, either as a percent of sales or as a percent of overhead, have remained constant or decreased somewhat since 1961 in virtually all of the industries surveyed. See Exhibit IX. This has occurred despite the fact that the ratio of non-production to production workers has remained relatively constant in most industries throughout the seventeen years under review. See Exhibit X. In other words, non-production labor costs do not appear to be the primary factor driving overhead costs and rates. Indeed, the data shows that labor's direct share of the value of industrial output has remained constant at best and, at worst, trended downwards since the early to mid 1970s. See Exhibit XI.

Factors of production other than labor are driving overhead costs and rates upwards creating, we believe, unanticipated structural changes in our economy, changes that may not be responsive to policies predicated on traditional economic theory.

F. "Good" and "Bad" Overhead Rates

In our opinion, normative judgments about an industry's or a firm's behavior cannot be made from a simple observation of its overhead costs or rates. As we have defined it, the overhead rate is no more than a description of the arithmetic relationship between overhead costs and direct labor costs. Actually, neither a low overhead rate nor a high one is either good or bad; the ratio simply describes what is happening in an industry and primarily reflects trends within the economy as a whole and an industry in particular. Further, as alluded earlier, we do not believe that it is possible to draw any normative conclusions from a comparison of the overhead rates of companies within the same industry as they may be reported by those companies. Inter-company rates will vary based on such factors as the cost definition practices used by a company; the degree of mechanization of a specific plant or division; the specific marketing or production policy of the company in question; and a range of other factors many of which represent management's current view of corporate organization and strategy.

The relevant factor to be considered in an analysis of overhead costs and rates is the absolute amount of overhead dollars absorbed in the manufacture of a product and not the arithmetical relationship between direct labor costs and overhead rates. A relatively higher overhead rate, our prior discussion notwithstanding, may be evidence of labor saving investments in plant and equipment or the more efficient use of production line labor. Indeed, in one prior investigation[1] of the cost structure of two competing companies it was found that the company with the

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[1] Building Naval Vessels: A Handbook of Shipyard Costs, Edward M. Kaitz & Associates, Inc., 1979.

higher overhead rate spent less on overhead per dollar of output than did its competitor. In other words, the company with the higher overhead rate was the more efficient of the two companies. In sum, the value of the overhead cost absorbed in the manufacture of a specific product is a more reliable measure of the productive efficiency of a company than is the overhead rate. In the final analysis, the bottom line of any cost analysis is the final <u>total</u> cost of producing a product.

EXHIBIT I: INDUSTRIES SELECTED FOR STUDY

INDUSTRY	SIC CODE
Fabricated Structural Metal	3441
Sheet Metalwork	3444
Iron and Steel Forgings	3462
Valves and Pipe Fittings	3494
Turbines, Turbine Generator Sets	3511
Machine Tools, Metal-Cutting	3541
Machine Tools, Metal-Forming	3542
Special Dies, Tools, Jigs, etc.	3544
Pumps and Pumping Equipment	3561
Ball and Roller Bearings	3562
Air and Gas Compressors	3563
Speed Changers, Drivers, Gears	3566
Electronic Computing Equipment	3573
Motors and Generators	3621
Radio/ T.V., Communication Equipment	3662
Semiconductors, Related Devices	3674
Aircraft	3721
Aircraft Engines, Related Devices	3674
Shipbuilding and Repairing	3731
Guided Missiles, Space Vehicles	3761
Tanks and Tank Components	3795

EXHIBIT XI

OVERHEAD RATES: SELECTED INDUSTRIES[1]

1961 - 1977

(%)

YEAR	3441	3444	3462	3494	3511	3541	3542	3544	3561	3562	3563
1961	141	140	97	189	242	170	137	94	237	147	N.A.
1962	131	133	108	193	178	171	147	98	225	147	N.A.
1963	131	139	101	192	163	150	158	87	237	138	N.A.
1964	125	146	129	184	174	163	151	101	235	129	N.A.
1965	137	146	107	202	143	173	137	94	234	140	N.A.
1966	148	153	118	211	130	170	154	105	240	134	N.A.
1967	163	163	127	211	189	185	136	103	251	137	N.A.
1968	161	166	127	216	194	199	185	104	263	138	N.A.
1969	157	166	126	185	248	176	154	99	255	113	N.A.
1970	163	186	113	203	201	195	153	101	254	120	N.A.
1971	178	177	116	221	186	204	173	80	267	125	N.A.
1972	171	183	127	202	308	171	151	109	224	128	291
1973	175	198	123	210	306	170	131	115	396	132	261
1974	187	208	144	235	279	197	111	115	400	136	249
1975	217	214	176	257	287	245	200	117	451	151	323
1976	204	221	180	254	314	247	198	112	490	150	345
1977	196	225	172	263	296	232	214	117	299	147	348
INCREASE: 1961 - 1977	39	61	77	39	22	37	56	23	26	0	--
INCREASE: 1970 - 1977	33	21	54	30	47	19	40	16	18	23	20

FAB STRUC MET | CRUCIF MET | FORGINGS | VALVES/PIPE | TURBINE SETS | MACH TOOL, MET-CUT | MACH TOOL, MET-FORM | DIES, TOOLS, JIGS | PUMPS | BEARINGS | COMPRESSORS

[1] Based on U.S. Department of Commerce Data.

EXHIBIT II (Continued)

OVERHEAD RATES: SELECTED INDUSTRIES[1]

1961 - 1977

(a)

YEAR	1366	1573	3621	3662	3674	3721	3724	3731	3761	3795
1961	175	N.A.	165	239	N.A.	198	204	62	N.A.	N.A.
1962	166	N.A.	165	212	N.A.	197	205	65	N.A.	N.A.
1963	167	249	163	251	189	223	220	60	369	181
1964	164	264	174	258	190	184	247	67	N.A.	127
1965	170	240	162	264	194	219	234	64	438	206
1966	170	288	167	239	195	265	206	65	N.A.	136
1967	184	350	177	238	162	201	231	78	469	93
1968	194	368	173	269	168	240	237	58	457	140
1969	184	344	167	298	164	261	245	57	476	216
1970	188	381	158	316	181	263	271	85	480	230
1971	201	401	175	337	266	303	258	79	415	236
1972	185	625	182	301	370	257	215	79	413	160
1973	562	495	169	315	314	311	247	95	455	144
1974	548	524	180	331	307	313	246	98	449	120
1975	617	566	213	347	384	336	257	100	446	161
1976	N.A.	750	207	369	438	348	301	103	477	128
1977	250	658	212	365	401	358	264	111	493	120
INCREASE:										
1961 - 1977	43	164	29	53	112	81	29	79	34	(34)
INCREASE:										
1970 - 1977	[illegible]	73	34	16	122	36	(3)	31	10	(48)

[illegible] [illegible] [illegible] [illegible] SEMICOND AIRCRAFT AIRCRAFT ENG SHIPS MISSILES [illegible]

[1] Based on U.S. Department of Commerce Data.

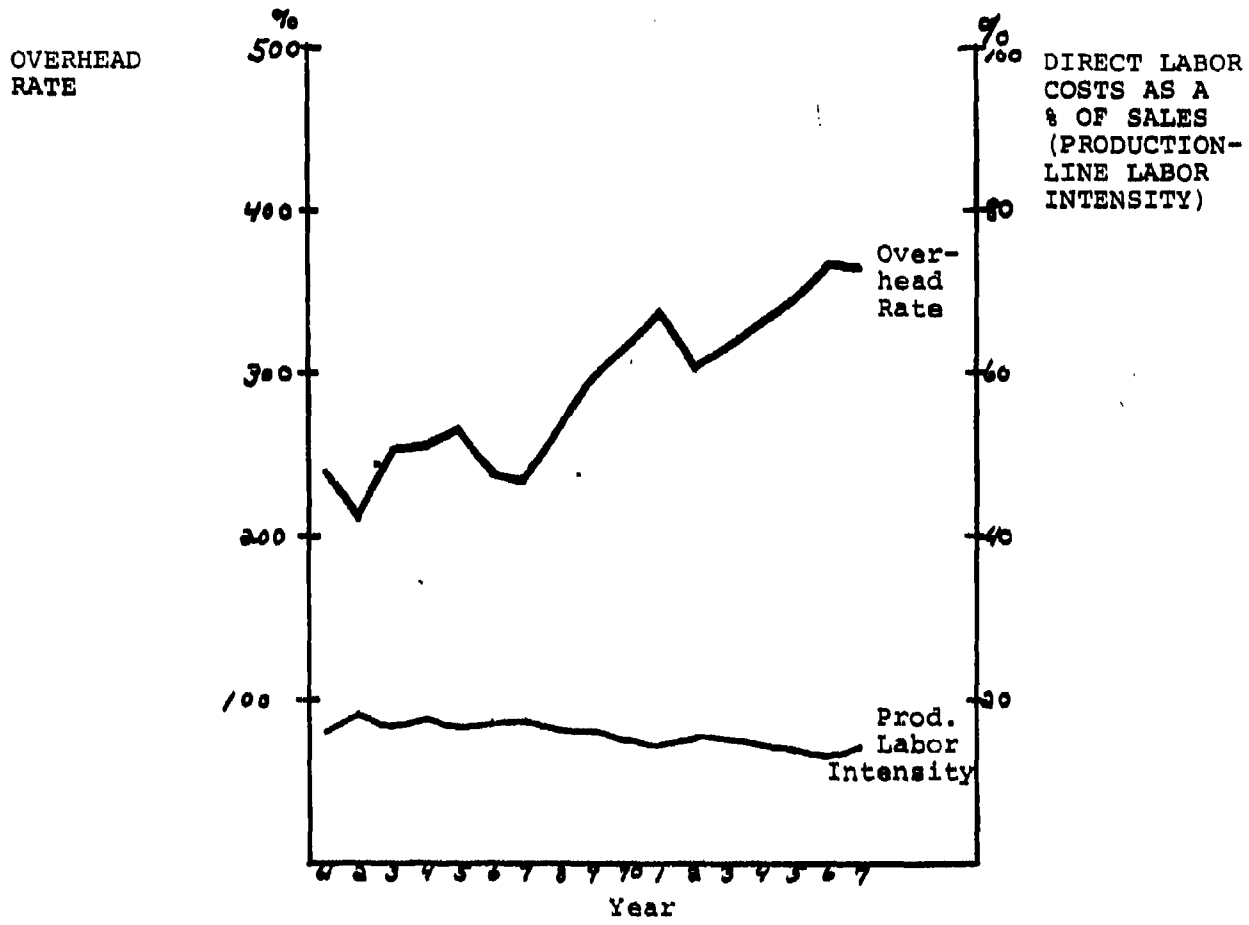


EXHIBIT III

PRODUCTION-LINE LABOR INTENSITY[1]

OVERHEAD RATE

RADIO/TV COMMUNICATION EQUIPMENT INDUSTRY

(ELECTRONICS) SIC 3662

1961 - 1977

[1]As measured by direct labor costs as a % of sales.

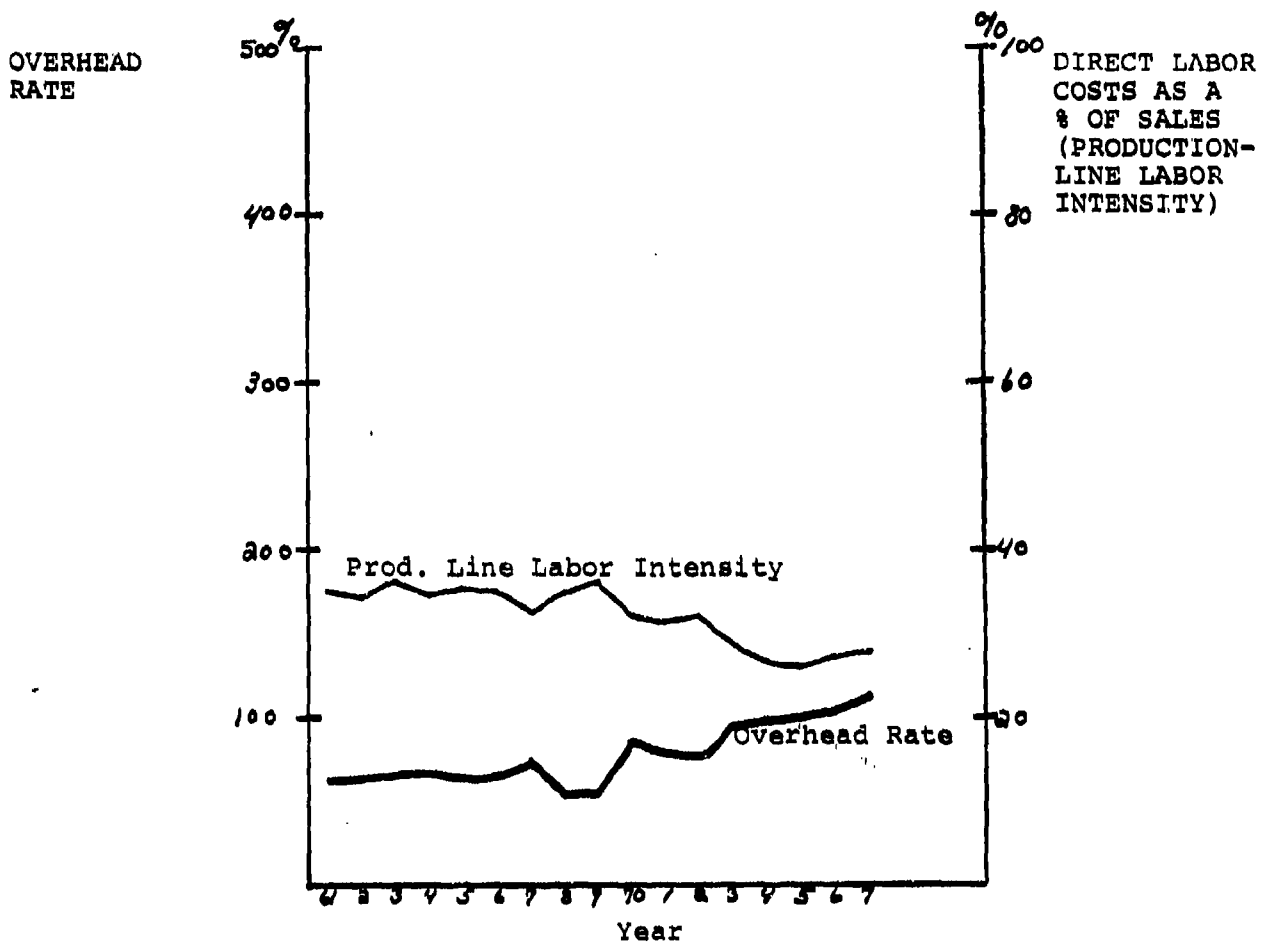


EXHIBIT IV

PRODUCTION-LINE LABOR INTENSITY[1]

OVERHEAD RATE

SHIPBUILDING AND REPAIR INDUSTRY

SIC 3731

1961 - 1977

[1]As measured by direct labor costs as a % of sales.

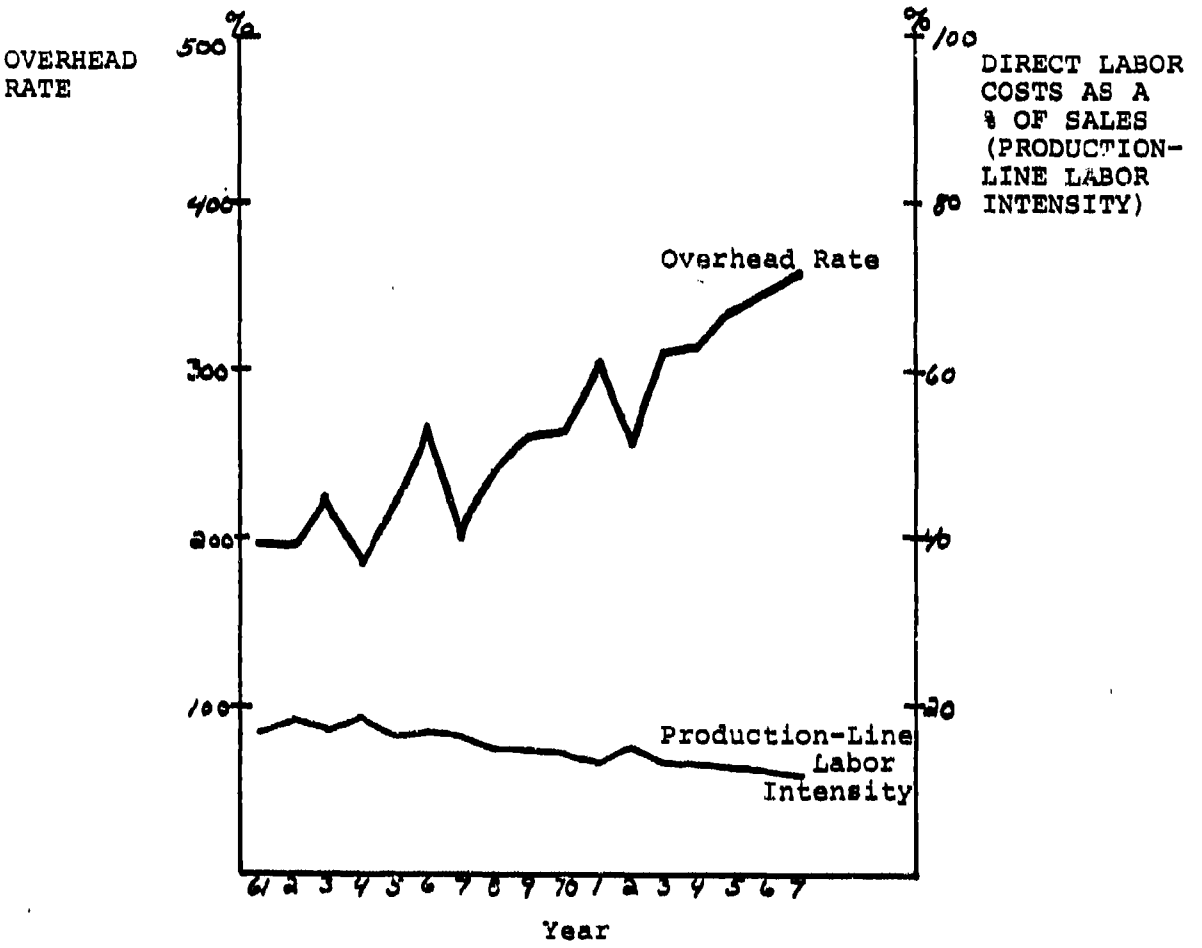


EXHIBIT V

PRODUCTION-LINE LABOR INTENSITY

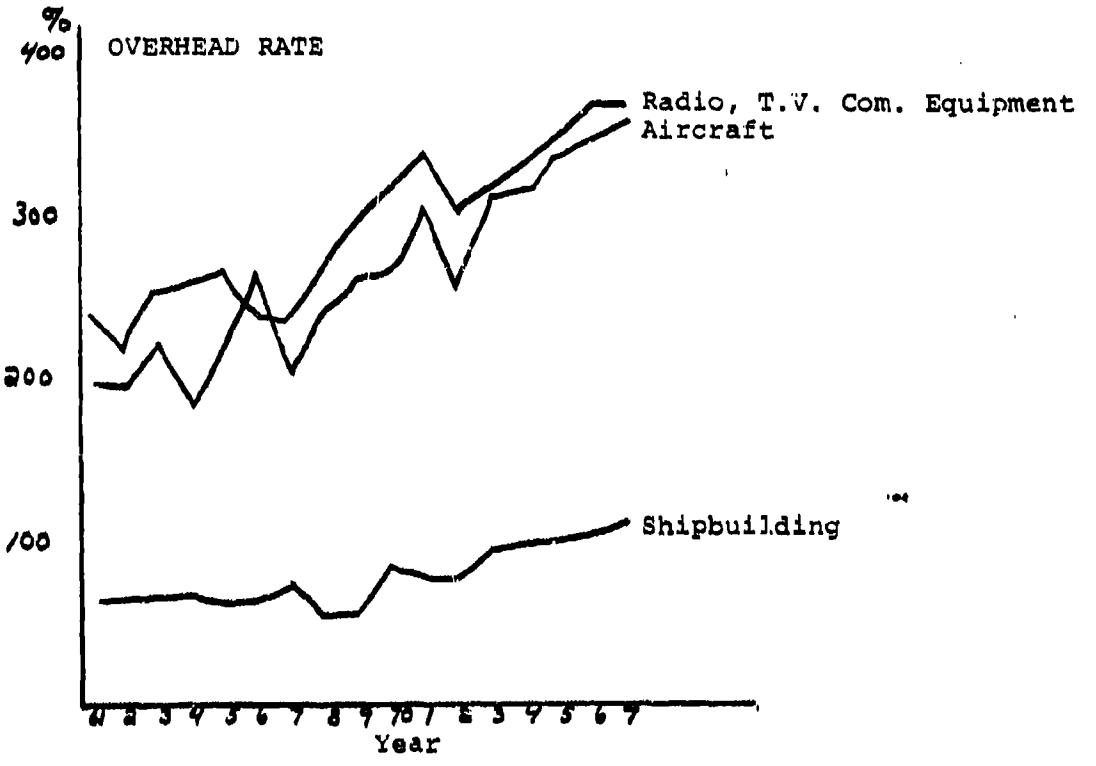
OVERHEAD RATE

AIRCRAFT INDUSTRY

SIC 3721

1961 - 1977

[1]As measured by direct labor costs as a % of sales.



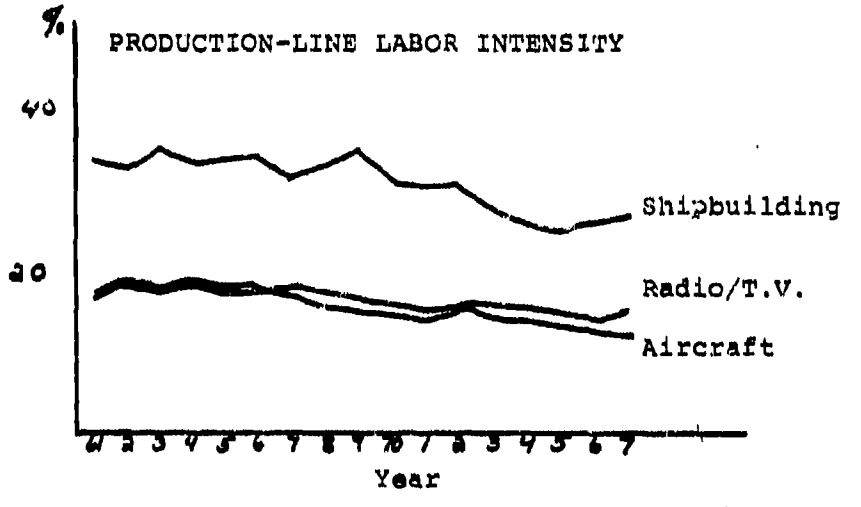


EXHIBIT VI
OVERHEAD RATES
AND
PRODUCTION LINE LABOR INTENSITY
1961 - 1977

EXHIBIT VII

DIRECT LABOR COSTS AS A % OF SALES: SELECTED INDUSTRIES[1]

1961 - 1977[2]

(%)

YEAR	3441	3444	3462	3491	3511	3541	3542	3544	3561	3562	3563
1961	17.8	19.9	24.1	19.6	18.7	24.4	24.4	38.3	15.9	26.1	N.A.
1962	17.6	20.5	23.4	19.9	22.0	23.9	24.6	37.2	16.5	26.0	N.A.
1963	18.3	20.3	22.5	20.2	23.1	25.6	24.3	39.1	15.9	26.3	N.A.
1964	17.9	20.1	22.3	20.4	22.0	23.9	24.2	37.1	15.2	26.3	N.A.
1965	17.5	19.0	21.9	19.1	22.9	23.2	23.8	37.2	15.9	25.3	N.A.
1966	17.1	19.0	21.1	18.6	22.3	23.4	22.5	35.8	15.7	25.7	N.A.
1967	17.2	18.5	21.1	18.9	18.8	22.4	23.1	36.3	15.2	25.9	N.A.
1968	17.3	18.4	21.0	18.7	16.8	22.0	21.9	36.4	14.9	26.0	N.A.
1969	17.8	18.9	20.8	18.8	15.6	23.2	23.7	37.0	15.3	27.8	N.A.
1970	17.3	19.1	22.3	18.8	15.6	21.8	24.8	35.4	15.4	27.4	N.A.
1971	16.3	18.4	21.9	18.0	15.7	21.3	21.4	40.4	14.7	46.0	N.A.
1972	16.2	16.9	20.8	19.1	13.7	23.0	23.6	35.0	16.8	28.4	13.8
1973	15.9	16.2	20.9	18.3	13.6	22.1	23.1	34.1	11.3	25.6	14.2
1974	14.8	14.9	18.7	16.7	13.7	20.6	25.7	33.7	10.3	24.3	14.2
1975	14.9	14.3	17.1	15.9	12.9	17.9	18.8	33.7	9.8	22.6	13.1
1976	15.2	13.2	17.0	16.5	12.6	19.0	21.0	34.1	9.0	23.0	11.3
1977	14.2	13.1	17.0	16.0	13.6	19.0	19.3	32.2	13.5	22.6	12.1

YEAR	3441	3444	3462	3491	3511	3541	3542	3544	3561	3562	3563
	FAB. STRUC. STEEL	SHEET MET.	FORGINGS	VALVES/PIPE	TURB/GEN SETS	MACH. TOOL, MET-CUT	MACH. TOOL, MET-FORM	PIPE, TUBING, WIRE	PUMPS	BEARINGS	COMPRESSORS

[1] Based on U.S. Department of Commerce data.

EXHIBIT VII (continued)

DIRECT LABOR COSTS AS A % OF SALES: SELECTED INDUSTRIES[1]

1961 - 1977

(%)

YEAR	2066	2073	2082	2084	2674	2761	2784	3721	3761	3795
1961	23.3	N.A.	22.3	16.1	N.A.	17.1	17.6	35.1	N.A.	N.A.
1962	23.2	N.A.	21.6	18.1	N.A.	18.2	17.7	34.6	N.A.	N.A.
1963	23.0	13.5	22.2	17.2	24.6	17.4	17.0	36.3	13.4	12.2
1964	23.0	13.2	21.6	18.0	24.6	18.5	16.3	34.7	12.0	12.5
1965	22.1	13.7	21.9	17.2	25.0	16.3	17.6	35.5	12.8	15.5
1966	21.8	11.2	21.6	17.7	24.4	17.0	16.1	35.0	12.9	10.1
1967	21.7	11.9	21.4	17.7	26.9	16.3	16.5	32.5	12.7	17.3
1968	21.1	11.8	21.5	16.6	25.8	14.8	15.8	34.0	13.9	14.2
1969	21.4	11.8	21.7	16.1	24.7	14.9	15.4	36.3	13.0	13.7
1970	21.4	11.5	22.2	15.6	23.0	14.5	14.9	32.4	13.5	13.8
1971	20.7	11.3	20.8	14.9	18.8	13.3	14.0	31.8	14.2	13.0
1972	21.0	7.6	20.6	15.8	19.5	15.2	14.6	33.1	14.0	17.3
1973	9.2	8.9	21.1	15.5	19.2	13.6	16.4	28.6	12.1	17.1
1974	9.0	8.7	19.3	14.8	14.8	13.4	16.4	26.8	11.4	21.0
1975	8.5	8.5	18.1	14.1	13.0	12.4	15.2	26.0	11.8	17.1
1976	N.A.	8.8	18.6	13.7	11.9	12.2	14.0	27.5	11.5	15.4
1977	18.0	7.5	18.2	11.0	12.5	11.9	14.9	27.0	11.7	16.7

2066 Distilled, Rectified, Blended Liquors
2073 Fats and Oils, Except Cottonseed Oil
2082 Malt Beverages
2084 Wines, Brandy, and Brandy Spirits
2674 Bags, Except Textile Bags
2761 Manifold Business Forms
2784 Gummed Products, Not Elsewhere Classified
3721 Aircraft
3761 Guided Missiles and Space Vehicles
3795 Tanks and Tank Components

[1]Based on U.S. Department of Commerce Data.

EXHIBIT VIII

CAPITAL EXPENDITURES PER DOLLAR OF SALES: SELECTED INDUSTRIES[1]

1961 - 1977

YEAR	3441	3444	3462	3494	3511	3541	3542	3544	3561	3562	3563
1961	.014	.020	.023	.021	.027	.023	.019	.031	N.A.	.039	N.A.
1962	.011	.025	.021	.024	.026	.027	.029	.033	.010	.034	N.A.
1963	.015	.020	.021	.025	.031	.037	.025	.038	.020	.039	N.A.
1964	.018	.021	.035	.027	.019	.033	.059	.032	.020	.040	N.A.
1965	.024	.022	.021	.023	.037	.035	.036	.044	.014	.051	N.A.
1966	.018	.022	.027	.031	.039	.041	.038	.060	.025	.065	N.A.
1967	.026	.024	.036	.044	.063	.037	.036	.052	.028	.081	N.A.
1968	.030	.024	.029	.033	.095	.030	.040	.054	.031	.056	N.A.
1969	.016	.024	.027	.030	.092	.037	.041	.043	.035	.049	N.A.
1970	.019	.022	.031	.032	.047	.027	.030	.034	.027	.043	N.A.
1971	.014	.022	.022	.027	.084	.022	.035	.038	.020	.068	N.A.
1972	.019	.022	.020	.027	.043	.025	.026	.040	.026	.033	.017
1973	.020	.000	.022	.032	.043	.020	.032	.035	.032	.040	.020
1974	.017	.020	.026	.031	.031	.024	.031	.057	.038	.052	.025
1975	.022	.022	.035	.036	.034	.019	.022	.037	.034	.044	.028
1976	.025	.044	.051	.038	.024	.026	.026	.050	.033	.038	.026
1977	.020	.032	.045	.030	.017	.028	.022	.045	.033	.052	.027
	FAB STRUC MET	SHEET MET	FORGINGS	VALVES/PIPE	TURB/GEN SETS	MACH TOOL, MET-CUT	MACH TOOL, MET-FORM	DIES, TOOLS, JIGS	PUMPS	BEARINGS	COMPRESSORS

[1]Based on U.S. Department of Commerce Data.

EXHIBIT VIII (continued)

CAPITAL EXPENDITURES PER DOLLAR OF SALES: SELECTED INDUSTRIES[1]

1961 - 1977

YEAR	1506	1573	3621	1662	3674	3721	3724	3731	3761	3795
1961	.035	N.A.	.019	N.A.	N.A.	.012	N.A.	.030	N.A.	N.A.
1962	.041	N.A.	.021	.017	N.A.	.019	N.A.	.014	N.A.	N.A.
1963	.039	.034	.021	.019	.076	.018	N.A.	.015	.016	.013
1964	.032	.030	.021	.019	.080	.018	N.A.	.018	.022	.003
1965	.038	.043	.032	N.A.	.067	.020	N.A.	.022	.014	.022
1966	.040	.034	.037	N.A.	.110	.042	N.A.	.023	.025	.008
1967	.040	.033	.041	.029	.115	.027	N.A.	.028	.024	.008
1968	.032	.031	.039	.032	.090	.022	N.A.	.031	.024	.006
1969	.037	.049	.039	.026	.092	.027	N.A.	.034	.019	.032
1970	.040	.050	.042	.027	.065	.018	N.A.	.054	.016	.008
1971	.028	.048	.042	.022	.059	.006	N.A.	.033	.014	.002
1972	.029	.033	.023	.022	.063	.006	.020	.043	.018	.011
1973	.031	.028	.028	.024	.092	.011	.020	.033	.017	.013
1974	.036	.032	.035	.026	.111	.010	.022	.046	.018	.006
1975	.033	.034	.030	.021	.086	.010	.028	.043	.015	.004
1976	.030	.036	.035	.027	.081	.011	.033	.050	.016	.014
1977	.039	.050	.036	.032	.077	.014	.027	.035	.024	.014

RADIO COMM, SERV, CHEMS | ELEC COMP EQPT | MOT, & GEN | SEMICOND | AIRCRAFT | AIRCRAFT ENG | SHIPS | MISSILES | TANKS

[1]Based on U.S. Department of Commerce Data.

EXHIBIT IX

INDIRECT LABOR COSTS AS A PERCENT OF SALES: SELECTED INDUSTRIES[1]

1961 - 1977

YEAR	3441	3444	3462	3494	3511	3541	3542	3544	3561	3562	3563
1961	9.5	9.6	8.6	11.9	15.7	16.2	13.8	12.1	12.9	11.0	N.A.
1962	9.4	9.4	9.3	11.4	15.4	17.0	13.8	10.4	13.0	10.2	N.A.
1963	9.2	8.3	7.1	11.3	15.6	15.7	12.5	10.1	12.1	8.6	N.A.
1964	8.9	8.5	6.5	11.2	13.4	14.9	11.5	10.2	12.0	8.1	N.A.
1965	8.9	8.2	5.9	10.9	13.0	13.9	11.5	10.7	11.7	7.8	N.A.
1966	8.5	8.3	6.1	10.5	12.3	13.4	11.1	10.6	11.3	7.5	N.A.
1967	8.9	8.6	6.3	11.2	11.8	13.3	11.9	10.6	11.6	8.4	N.A.
1968	9.3	8.8	6.4	11.4	11.9	14.0	12.4	10.7	11.8	7.4	N.A.
1969	9.2	8.8	6.4	11.2	12.0	15.2	13.6	11.3	11.6	8.5	N.A.
1970	9.1	9.1	7.2	11.4	11.3	15.9	13.4	11.3	12.2	9.2	N.A.
1971	8.9	9.0	7.0	11.1	11.1	16.4	14.8	7.6	12.6	8.7	N.A.
1972	8.7	8.4	6.6	9.6	11.4	17.5	14.5	11.1	10.9	8.0	12.7
1973	8.5	7.7	5.9	11.0	12.0	15.4	13.4	10.8	10.3	7.6	12.4
1974	8.0	7.1	5.3	9.9	11.4	14.7	8.1	10.5	16.3	7.1	11.6
1975	7.9	7.0	5.3	10.1	11.2	13.1	12.2	11.3	15.0	7.2	10.7
1976	8.4	7.2	5.8	10.3	11.7	14.9	11.5	11.0	14.1	7.1	9.3
1977	8.7	7.1	5.9	9.9	12.6	14.7	12.4	11.8	10.5	6.7	10.0

3441 STRUC MET
3444 SHEET MET
FORGINGS
VALVES/PIPE
TURB/GEN SETS
MACH TOOL, MET-CUT
MACH TOOL, MET-FORM
DIES, MOULD, JIGS
PUMPS
BEARINGS
COMPRESSORS

[1]Based on U.S. Department of Commerce Data.

EXHIBIT IX (continued)

INDIRECT LABOR COSTS AS A PERCENT OF SALES: SELECTED INDUSTRIES[1]

1961 - 1977

YEAR	3566	3573	3621	3662	3674	3721	3724	3731	3761	3795
	PWR TRANS, GEARS	ELEC COMP EQPT	MOT & GEN	RADIO/TV COM EQPT	SEMICOND	AIRCRAFT	AIRCRAFT ENG	SHIPS	MISSILES	TANKS
1961	12.9	N.A.	14.2	21.9	N.A.	19.7	18.3	9.9	N.A.	N.A.
1962	12.6	N.A.	12.9	20.5	N.A.	21.6	18.7	9.3	N.A.	N.A.
1963	11.1	12.2	11.9	22.5	22.1	20.1	19.3	10.2	29.8	7.4
1964	10.6	12.6	11.9	22.6	21.1	16.8	20.8	10.2	32.8	8.8
1965	10.3	13.4	10.5	23.8	19.0	18.7	19.7	10.0	31.8	10.0
1966	9.9	11.1	10.3	23.2	19.6	18.8	18.6	10.2	29.7	8.4
1967	10.7	12.6	10.5	24.0	20.9	15.9	17.1	10.2	32.6	8.4
1968	11.1	13.5	10.6	23.5	20.0	15.2	17.1	10.7	33.5	7.3
1969	11.0	14.6	10.2	24.9	20.2	17.8	19.3	11.1	32.8	7.6
1970	11.6	16.1	10.8	25.1	21.3	17.0	19.7	10.9	32.4	8.3
1971	12.2	18.3	10.8	24.7	22.4	16.2	19.5	10.9	30.1	7.8
1972	10.7	19.0	9.8	23.4	19.7	17.5	23.5	11.3	28.3	6.6
1973	N.A.	16.5	9.1	23.3	17.8	15.1	16.7	10.8	26.9	6.2
1974	N.A.	15.6	9.0	22.4	19.5	14.8	16.4	9.9	25.4	7.7
1975	N.A.	17.0	9.0	23.5	22.9	15.0	15.3	9.5	24.8	5.4
1976	N.A.	16.8	8.5	21.2	18.8	14.4	14.9	10.2	26.8	4.9
1977	11.3	15.9	8.5	20.6	17.6	14.9	14.9	10.5	25.7	5.6

[1]Based on U.S. Department of Commerce Data.

EXHIBIT X

RATIO OF NON-PRODUCTION LINE WORKERS TO PRODUCTION LINE WORKERS: SELECTED INDUSTRIES[1]

1961 - 1977

YEAR	3441 FAB STRUC MET	3444 SHEET MET	3462 FORGINGS	3494 VALVES/PIPE	3511 TURB/GEN SETS	3541 MACH TOOL, MET-CUT	3542 MACH TOOL, MET-FORM	3544 DIES, TOOLS, JIGS	3561 PUMPS	3562 BEARINGS	3563 COMPRESSORS
1961	35.5	31.3	28.0	40.7	61.9	52.6	27.8	21.6	59.5	25.0	N.A.
1962	33.9	30.6	24.2	39.7	57.1	51.3	27.8	20.2	63.2	23.3	N.A.
1963	32.8	29.2	24.1	37.9	55.0	48.8	37.5	19.7	56.4	23.8	N.A.
1964	33.3	28.6	23.3	39.0	50.0	44.4	35.3	19.0	58.1	25.6	N.A.
1965	32.9	26.9	21.9	39.7	45.8	44.9	36.8	21.1	57.5	21.3	N.A.
1966	32.9	28.6	24.2	39.4	41.7	45.5	33.3	18.8	54.9	22.0	N.A.
1967	33.0	28.3	24.2	39.7	44.0	42.6	38.1	18.8	56.0	22.9	N.A.
1968	33.3	28.3	21.9	41.2	52.0	43.8	47.4	20.2	58.3	25.5	N.A.
1969	36.3	29.1	21.2	41.2	62.5	50.9	47.4	21.1	58.0	22.9	N.A.
1970	35.1	33.3	24.1	42.6	62.1	54.3	45.0	21.7	56.8	24.4	N.A.
1971	35.7	37.8	22.2	42.4	53.1	63.6	50.0	22.2	63.0	26.3	N.A.
1972	35.1	32.1	25.9	43.3	58.6	55.9	41.2	24.1	59.2	24.4	64.3
1973	34.6	30.2	22.6	42.3	65.5	50.0	42.1	21.6	53.9	22.7	66.7
1974	35.1	33.9	21.9	42.1	61.3	47.7	45.0	20.6	51.2	22.2	63.2
1975	33.8	38.0	23.3	47.1	63.0	53.7	44.4	21.6	60.0	25.0	58.8
1976	36.6	37.7	26.7	45.1	66.7	53.6	43.8	23.6	61.5	22.5	68.8
1977	37.5	37.5	25.8	44.6	64.0	57.9	50.0	23.3	57.5	24.4	68.4

[1]based on U.S. Department of Commerce Data.

EXHIBIT X (continued)

RATIO OF NON-PRODUCTION LINE WORKERS TO PRODUCTION LINE WORKERS: SELECTED INDUSTRIES[1]

1961 - 1977

YEAR	3566	3573	3621	3062	3674	3721	3724	3731	3761	3795
1961	37.0	60.7	41.2	105.3	N.A.	76.3	73.4	18.6	N.A.	N.A.
1962	41.9	68.3	38.2	85.5	N.A.	81.1	73.8	19.1	N.A.	N.A.
1963	38.2	62.7	36.2	87.9	47.4	80.8	80.8	18.6	166.7	37.5
1964	33.3	63.5	37.7	94.0	44.7	77.5	92.1	18.6	N.A.	50.0
1965	35.9	66.7	32.5	89.8	36.7	71.5	81.1	18.2	168.5	60.0
1966	31.0	67.9	28.7	82.0	39.0	70.8	74.3	18.4	N.A.	42.9
1967	34.2	67.1	32.9	85.5	46.6	67.5	72.6	21.9	187.1	30.0
1968	35.9	69.8	31.2	93.6	42.6	69.9	77.8	20.3	166.1	44.4
1969	36.6	76.8	32.5	102.5	44.9	77.6	84.7	21.2	206.9	66.7
1970	39.5	71.7	32.9	109.7	48.3	88.2	83.3	22.6	186.0	60.0
1971	41.2	105.2	34.3	111.0	63.0	85.9	88.0	21.9	158.8	40.0
1972	37.8	106.0	31.9	96.9	69.0	77.1	75.0	22.9	145.8	20.0
1973	N.A.	109.3	27.9	98.2	60.0	73.2	70.1	25.6	160.0	20.0
1974	N.A.	103.4	28.2	99.4	62.2	71.9	70.6	25.6	165.9	40.0
1975	N.A.	120.3	34.4	97.5	86.5	80.3	74.2	25.6	170.7	14.3	
1976	N.A.	133.8	28.2	98.7	77.6	80.1	73.7	25.8	171.8	25.0
1977	38.9	124.4	30.7	94.6	82.3	87.4	68.3	26.6	167.5	20.0

3566 CHG, DRIV, GEARS | 3573 ELEC COMP EQPT | 3621 MOT & GEN | 3062 RADIO/TV, C-M EQPT | 3674 SEMICOND | 3721 AIRCRAFT | 3724 AIRCRAFT ENG | 3731 SHIPS | 3761 MISSILES | 3795 TANKS

[1] Based on U.S. Department of Commerce Data.

EXHIBIT XI

TOTAL LABOR COSTS AS A PERCENT OF SALES[1]

1961 - 1977

YEAR	3441	3444	3462	3494	3511	3541	3542	3544	3561	3562	3563
1961	27.3	29.5	32.7	31.5	34.3	42.6	38.2	50.3	28.8	37.1	N.A.
1962	27.0	29.9	38.7	31.3	37.4	40.9	38.4	47.5	29.5	36.1	N.A.
1963	27.5	28.6	29.9	31.5	38.6	41.3	36.7	49.2	27.9	34.9	N.A.
1964	26.8	28.5	28.7	31.6	35.4	38.7	35.6	47.2	28.2	34.4	N.A.
1965	26.4	27.2	27.8	30.0	35.9	37.1	35.3	47.9	27.6	33.0	N.A.
1966	25.6	27.4	27.2	29.1	34.6	36.9	33.7	46.4	26.9	33.2	N.A.
1967	26.1	27.1	27.4	30.1	30.6	35.7	35.0	46.9	26.8	34.3	N.A.
1968	26.5	27.2	27.4	30.1	28.7	36.0	34.3	47.1	26.7	34.4	N.A.
1969	27.1	27.7	27.2	30.0	27.6	38.4	37.3	48.2	26.8	36.2	N.A.
1970	26.4	27.1	29.5	30.2	27.0	37.5	36.2	46.6	27.6	36.6	N.A.
1971	25.0	27.4	28.8	29.1	26.8	39.7	36.2	48.0	27.2	34.7	N.A.
1972	24.9	25.3	27.3	28.8	25.1	40.5	38.1	46.1	27.7	34.4	26.5
1973	24.4	23.9	26.8	29.3	25.5	37.5	36.6	44.9	27.1	33.2	26.6
1974	22.9	22.0	23.9	26.6	25.0	35.2	33.8	44.2	26.5	31.3	25.4
1975	22.8	22.1	22.3	26.0	24.1	31.2	31.0	45.0	24.5	29.8	22.7
1976	23.6	20.4	22.8	26.8	24.3	33.8	31.5	45.1	25.1	30.1	20.6
1977	24.0	20.2	22.9	25.9	26.2	33.7	31.8	41.7	24.0	29.3	22.1

VAR STRUC MET | SHEET MET | FORGINGS | VALVES/PIPE | TUBS/GEN SPEC | MAC TOOL, MET-CUT | MACH TOOL, MET-FORM | DIES, TOOLS, JIGS | PUMPS | BEARINGS | COMPRESSORS

[1] Based on U.S. Department of Commerce Data.

EXHIBIT X[1] (continued)

TOTAL LABOR COSTS AS A PERCENT OF SALES

1961 - 1976

YEAR	3566	3573	3621	3662	3674	3721	3724	3731	3761	3795
1961	35.9	N.A.	36.4	38.1	N.A.	36.8	35.9	48.0	N.A.	N.A.
1962	35.8	N.A.	34.7	38.7	N.A.	39.8	36.4	43.9	N.A.	N.A.
1963	34.1	25.7	34.1	33.7	46.7	37.5	36.3	46.4	43.2	19.5
1964	33.6	25.8	33.5	40.5	45.7	35.4	37.1	44.9	44.8	21.2
1965	32.4	27.1	32.4	41.0	44.0	35.1	36.8	45.5	44.6	25.5
1966	31.7	32.3	31.9	40.8	44.0	35.8	30.7	45.2	42.5	26.6
1967	32.4	24.5	31.9	41.7	47.8	32.2	33.6	42.7	45.2	25.6
1968	32.2	25.3	32.0	40.1	45.8	30.0	33.1	45.5	46.4	21.5
1969	32.4	26.4	31.9	41.0	44.9	32.7	33.7	47.3	45.8	21.3
1970	33.0	27.6	32.0	40.7	44.2	31.5	32.5	43.3	45.9	21.2
1971	32.9	29.6	31.6	39.5	41.1	29.4	34.4	42.7	44.3	20.9
1972	32.5	26.6	30.4	39.3	35.2	32.7	40.0	43.3	42.5	23.9
1973	N.A.	25.5	30.3	38.7	32.9	28.7	33.1	39.4	39.2	23.3
1974	N.A.	24.4	28.3	37.2	34.1	28.3	32.8	36.7	36.8	28.7
1975	N.A.	25.5	27.1	35.6	36.8	37.4	30.5	35.6	36.7	22.4
1976	N.A.	23.8	27.1	34.9	30.6	26.8	28.9	37.6	37.9	20.3
1977	29.9	23.4	26.6	34.7	30.0	26.8	29.8	38.3	37.5	22.3
	SPEED CHG, INDV, GEARS	ELEC COMP EQPT	MOT & GEN	RADIO/TV, COM EQPT	SEMICOND	AIRCRAFT	AIRCRAFT ENG	SHIPS	MISSILES	TANKS

[1] Based on U.S. Department of Commerce Data.

CHAPTER II: ANALYSES OF THE AIRCRAFT AND ELECTRONICS INDUSTRIES

A. Introduction

In order to begin a more detailed analysis of overhead costs and overhead rates, we elected to analyze the data on two key defense-oriented industries; the Aircraft Industry (SIC 3721) and the Radio/T.V. and Communication Equipment Industry (Electronics - SIC 3662). In terms of acquisition dollars, these two industries in conjunction with the shipbuilding industry are the three largest and most important segments of the so-called defense industries. Of the three, the potentially less visible electronics industry may have the more critical impact on such purely military issues as doctrine and force structure.

Exhibit XII depicts graphically employment and overhead trends within the aircraft industry with the long term trend in overhead rates compared to employment trends in the industry from 1961 through 1977. As is shown in the exhibit, overhead rates in the aircraft industry have trended upwards from a base of 198 percent of direct labor costs in 1961 to a rate of 358 percent in 1977. The more general trend, however, was broken at least temporarily in 1967 and 1968 when industry sales and employment broke all previous peacetime records and the proportion of production line workers to the total work force increased reasonably substantially, i.e., from about 57 percent in 1961 of total work force to 60 percent in 1967. See Exhibit XIII.

As employment in the aircraft industry began winding down after 1968, overhead rates once again began to climb,

dropping only in 1972 when the industry retrenched financially even more sharply than the data on employment would suggest. In 1972, the number of non-production workers dropped 8.2 percent. Sales dropped 5.7 percent to their lowest level since 1965.

The same data for the militarily vital Radio/T.V. and Communication Equipment Industry is shown in Exhibits XIV and XV. As with the aircraft industry, the long term trend in the overhead rate in this industry has continued to increase, i.e., from 239 percent of direct labor in 1961 to more current rates of approximately 365 percent in 1977. The general upward trend was interrupted twice, once in 1962 and again in 1966 and 1967 when, as with the aircraft industry, the size of the production line labor force peaked. Employment began dropping after 1969, with the greatest proportional drop occurring in the production line category. As shown in Exhibit XV, this ratio has now stabilized at an approximately 1:1 ratio between production line and non-production line employees.

If the number of production line employees is used as a surrogate for levels of output, it is reasonably obvious that the physical output of both of these industries dropped precipitously in the 1966 to 1970 time frame. Consistent with the traditional notion of overhead as a fixed cost, overhead rates per se increased sharply as attempts were apparently made to retain overall corporate capabilities despite a potentially long term and irreversible decline in the demand for each industry's output. Put another way, it would appear the sales dollar spent by the consumer in each of these industries is now buying less and less physical output with an increasing portion of the sales dollar being used to maintain overall corporate capabilities. In light of the substantial role

that defense procurements play in the sales volume generated by both of these industries, this outcome should have been anticipated. For so long as the government believes that a large industrial base needs to be maintained against either a mobilization or technological contingency, it must pay the inherent, long term cost of providing for that capability.

Exhibits XVI and XVII provide support for this important contention on corporate behavior within the aircraft and the electronics industries. Both of these exhibits present data on production line wage scales within the industry and the overhead costs allocated to the production line worker, i.e., the total of his wages and the overhead costs that must be absorbed by him if the full cost of corporate operations is to be recovered through the pricing mechanism. As the exhibits show, production line wage scales as such have had a relatively minor impact on overall corporate costs over the full time span set out in the exhibits. Other costs have risen much more rapidly and, indeed, may be regarded as the key factor driving unit prices within each of these industries.

By adding material costs to the loaded wage set out in the earlier exhibits, Exhibits XVIII and XIX present data on the total resources used per production line worker in each of these two industries. The relatively minor impact of changes in production line wages on total product cost is reflected once again in these exhibits. In other words, for each of these two industries, production line wages per se are not the cause of the rapid increase in product costs these past five to ten years. The rapid increase in the cost of raw material, and the equally if not more rapid run-up in overhead costs provide a

far better explanation of the reasons for the escalation in prices in both of these industries and, indeed, in a broad range of U.S. industries. Here we are worrisomely aware of the fact that our data does not support the generally accepted explanation that wage scales, per se, are the underlying factor driving costs in the United States. Wages have increased substantially irrespective of the measure used but, at least in the aircraft and electronics industries, wage payments as such represent an ever decreasing proportion of the sales dollar whether these payments be made for production line or non-production line wages. Data in this outcome is presented in Exhibit XX.

Once again, this data is consistent with the notion that overhead costs are, for the most part, fixed, and not subject to drastic control by management in the short run and, indeed, even in the long run. The more critical question is the reason for management's failure and/or inability to scale these costs down commensurate with a long term decline in the demand for the industries' output. Conventional industrial theory would suggest that management restructure the entire firm consistent with a more long term business outlook and, in so doing, free up cash for investments in more promising areas. To the best of our knowledge this has not happened in the electronics industry and but once in the aircraft industry, e.g., the Boeing Company successfully scaled down its operation from over 100,000 persons in the late 1960s to somewhat less than 40,000 persons in the early 1970s. In so doing, Boeing propositioned itself for dominating the U.S. aerospace industry in the 1980s and 1990s. In a very critical sense, Boeing is rapidly becoming a "national champion" that should be able to withstand all forms of international competition for quite some time to come. The same is not true, however, for the

other firms in the aircraft industry. Given the projected growth of the European and Japanese aircraft industry and the continuing need for the aircraft industry to contribute positively to our pervasive balance of payments problem, the continuing growth and financial strength of Boeing is a major national asset from at least a macroeconomic perspective.

B. Indirect Labor Costs

In overall terms, the ratio between production line and non-production line workers has remained reasonably constant for both industries for the seventeen years for which data is currently available. In other words, indirect labor costs behave like variable costs; that is, they appear to vary directly with output despite the fact that these costs are generally accounted for in the overhead pool and, as such, are regarded as fixed. This relatively constant relationship between direct and indirect labor appears to obtain across virtually all of the 72 industries reviewed during the course of this report, an outcome which was not otherwise anticipated.

Industrially, this poses a severe problem in that it reduces substantially the quantity of costs which are actually fixed and, hence the basis for cost savings generated by an increase in demand. In other words, the possibility for productivity gains are made more limited if virtually all labor costs in an industry or a firm vary directly, or almost directly, with sales. It would suggest that extremely high levels of output are needed in a firm or industry before the growth in the size of the non-production labor force can be topped off, i.e., before labor-related, cost-saving economies of scale can be realized. If this is so, and the data would support this conclusion, then the imputed structure of American industry may have changed quite radically these past ten to fifteen years.

An analysis of the data on both the aircraft and electronics industry as well as other industries supports this contention.

C. The Aircraft Industry

From 1961 through 1977, the production line labor force in the aircraft industry varied from a low of 53 percent to a high of 60 percent of the total work force in the industry with the more general average centered around 55 percent. In 1968, the ratio was a slightly higher 59 percent. See Exhibit XXI. In keeping with the absolute increase in the size of the production line work force, material costs as a percent of sales increased to 51 percent in 1967 and 50 percent in 1968 versus a more general average within the industry of between 44 percent and 46 percent. See Exhibit XXII. In other words, material utilization rates appear to have increased substantially these two years as the increase in the size of the labor force either generated or allowed for increased efficiencies on the production lines.

As might be expected, overhead rates dropped during this period as a greater proportion of each dollar of sales was used up on the production line. In other words, as throughput increased, unit overhead costs, measured as a percent of sales, decreased. For 1967, the rate was an extremely low 200 percent. In 1968, the rate was 240 percent. Although appreciably higher than the rate for 1967, the 1968 rate is still appreciably lower than the long term trends in the industry would otherwise suggest.

Based on these three factors, then, it would appear safe to assume that the industry was operating at or near its capacity for the two years, and that it was operating efficiently based on any historic norm.

A review of other data on the aircraft industry tends to confirm this. Industry sales peaked in 1968 at a peacetime record of $13.0 billion, a sales record that was not reached again until 1976 when prices had been sharply increased by inflationary factors in our economy. See Exhibit XXIII.

Similarly, employment within the industry broke all prior and future records when it peaked in 1968 at 418,000 persons or some 110,000 to 120,000 persons more than were employed in a peacetime work force in 1961. More significant than the peaking in the size of the total labor force, however, is the more rapid relative growth in the number of production line workers. In other words, indirect labor, heretofore a variable cost, became fixed or semi-fixed in 1967 and 1968 when industry output apparently reached a "critical mass". Based on an admittedly simple extrapolation of our data, it seems safe to conclude that it was not until the industry, as it was then organized, reached a level of some 360,000 to 370,000 persons that the size of the production line labor force was either allowed to or able to grow faster than that of the non-production labor force, i.e., that labor-related economies of scale were realized. Although it is invalid to assume that the industry is organized today as it was then, it would still appear safe to conclude that the 240,000 people now employed within the industry are well below the "critical mass" needed to insure cost-saving economies of scale within the industry. Substantial increases in the size of the work force would be required were this prior peak of efficiency to be replicated in today's environment.

Two caveats obtain here. The first is that what holds true for the industry as such does not necessarily hold true for specific firms within the industry. Individual firms within an industry may be large enough to automatically limit the growth of non-production line workers during a time when the production line labor force is being increased. If this is so, then those firms capable of exercising this control will gain a very critical long term edge over the market if fully competitive forces are allowed to obtain. Government policy may gravitate against this.

Second, we have assumed that the industry was more efficient in 1967, 1968 and even 1969 than in either prior or subsequent periods of time. The primary proof that we have here is persuasive but not conclusive: the absolute number of military aircraft produced and the rates of profit then earned by the industry. If this is a valid technique for assessing efficiency, then two conclusions may be drawn from the data:

- a relatively small increase in the ratio between the production line workers and the total work force employed in an industry may generate relatively substantial savings in unit costs. For the aircraft industry an increase in the ratio of from 55.0 percent to 58.0 percent to 60.0 percent is apparently significant.

- the overall effect of this relatively small increase in the percentage of production line workers in an industry is an increase in efficiency measured by a relatively small but nonetheless significant increase in the rate

> of material utilization per production line worker in the industry based on the measure of material utilization as a percent of sales. An increase in the cost of material as a percent of sales from 44 percent to 46 percent to 50 percent appears to have had a significant effect on unit costs in the aircraft industry during the years under review.

Based on this data, and a review of the data on other industries included in this work, we now believe that these two data points may be of value in assessing the relative efficiency of two or more competing firms within an industry, or the more general movement within an industry or company to or away from established levels of efficiency. Further, with proper research, we believe that the proper use of these two measures may allow for proper judgments on the optimal size of an industry or firm, given some projected level of future demand. However, analyses of this type are beyond the scope of this present project.

D. The Electronics Industry

The data on the electronics industry (Radio/T.V. and Communications Equipment - SIC 3662) is, unfortunately, not as straightforward as the data on the aircraft industry in that our two hypothesized indicators of efficiency peaked one to two years prior to the industry's sales. This would suggest that the industry grew larger, albeit less efficiently so, in the subsequent two years. It would also suggest that although sales volume and efficiency are normally related to one another, that the relationship cannot be taken for granted.

In support of our analysis, we find it significant that the overhead rates in the industry dropped below long term trends in the two years when our hypothesized measures of efficiency peaked, and climbed rather sharply thereafter reflecting some changes in the overall structure and/or output of the industry.

The initial peak years were 1966 and 1967, when material costs per dollar of sales were 40 percent. See Exhibit XXII. In these two years, the ratio of production line workers to total labor force workers was similarly at an all time high, i.e., 55 percent in 1966 and 54 percent in 1967. See Exhibit XXI. Intriguingly enough, the size of the production line labor force peaked in 1968 when 424,000 persons were employed within the industry of which 219,000 or some 52 percent were employed on the production line. In other words, 1969 saw a significant shift in employment patterns within the industry. As with our other measures, sales for 1966 and 1967 similarly reached new highs, although industry sales were then

some $1.0 billion lower than the peaks attained in 1968 and 1969. See Exhibit XXIII.

However, a significant portion of the increase in sales between 1967, 1968, and 1969 was the result of increases in the absolute amount of overhead absorbed in the final product cost. This reflects an increase in the number of non-production line employees within the industry. For 1966 and 1967, for example, overhead rates were a relatively low 240 percent of direct labor. In 1968, the rate increased to 270 percent and in 1969 to 300 percent. Both of these are higher than previously recorded in the industry although still appreciably less than the current norm within the industry.

In absolute dollars, overhead costs increased from $3.6 billion in 1967 to $4.3 billion in 1968 and $4.6 billion in 1969. In other words, overhead costs accounted for $700 million dollars of a $1,000,000,000 increase in sales between 1967 and 1968. By 1969, overhead accounted for a full 100 percent of the increase in sales between 1967 and 1969. Based on this, it seems safe to assume that either the structure of the industry, or the technological content of its output, or a combination of the two, changed during the years under review. In more technical terms, it seems reasonably safe to assume that the industry was somewhat less efficient in 1968 and 1969 than in 1966 and 1967.

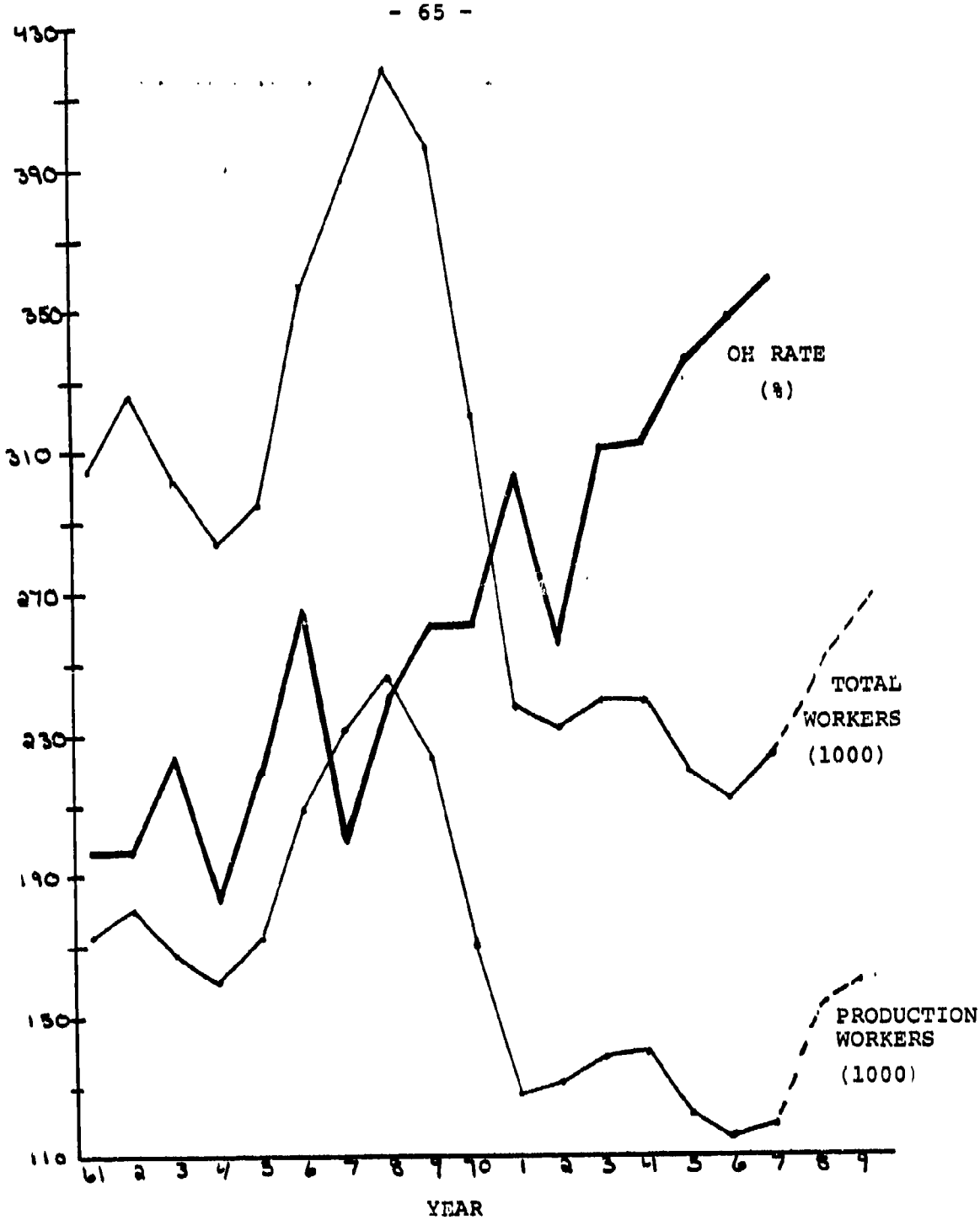
The more critical basis for this judgment is, we believe, the rate of capacity utilization in the industry as measured by material costs as a percent of sales. Where there has been a substitution of capital for labor, overhead rates will increase as the size of the base against

which they are computed decreases. However, as capital is substituted for labor, or as efficiency in the use of labor is attained, the cost of material as a percent of sales should increase. This did not happen in the electronics industry in 1968 and 1969 and is the ultimate basis for our suggesting that the industry was at least nominally less efficient in these years than in 1966 and 1967.

Here a word of caution is in order. Efficiency is a comparative term. For the consumer, it generally means the lowest price possible for a desired product. For the producer, efficiency is generally measured by rates of return on sales, assets or net worth. Where an industry can pass on higher prices to its consumers without dampening demand dangerously and by so doing increase profits, it is, in its own terms, operating efficiently. Thus, the reality of the marketplace would suggest that there is an inherent tension between the consumer's and the producer's need, with each party to the transaction sacrificing his position at one time or another in order to insure a reasonably orderly marketplace. Where there is evidence of a reasonably orderly market . . . a general characteristic of the U.S. economy these past ten to twenty years, if not indeed longer. . . it seems reasonably safe to assume that both the buyers' and the sellers' interests have been fulfilled equitably and that structural changes within industry are per se neither good nor bad but simply and descriptively representative of a series of trends or outcomes within the general economy.

In sum, we are suggesting that the increase in overhead costs and rates in U.S. industry, in general, and the two industries specifically reviewed in this chapter, is neither good nor bad. Instead, it reflects underlying economic needs and trends. As such, the increased devotion of dollars

to corporate perpetuity and capability as we have defined may in fact be justified based on a broad range of social, political, economic and other considerations.



ESTIMATES____

EXHIBIT XII

WORKERS AND OVERHEAD RATE

AIRCRAFT

SIC 3721

1961-1979

EXHIBIT XIII

U.S. AIRCRAFT INDUSTRY: SIC 3721

SALES, EMPLOYMENT, PRODUCTION WORKERS AS A % OF TOTAL WORKERS

1961 - 1979

Year	Sales ($ million)	Employment (000)	Production Line Workers as a Percent of the Total Labor Force
1961	6,000	305	56.7
1962	6,206	326	55.2
1963	6,317	302	55.3
1964	6,584	284	56.3
1965	7,151	295	58.3
1966	9,000	357	58.5
1967	11,079	387	59.7
1968	13,014	418	58.9
1969	12,444	396	56.3
1970	10,996	320	53.1
1971	9,313	228	53.8
1972	8,779	232	56.5
1973	10,666	239	57.7
1974	11,665	239	58.2
1975	12,544	220	55.5
1976	13,420	209	55.5
1977	14,834	223	53.4
1978[1]	19,630	244	60.7
1979[1]	28,000	273	59.7

SOURCE: U.S. Department of Commerce, Bureau of the Census

[1] estimated

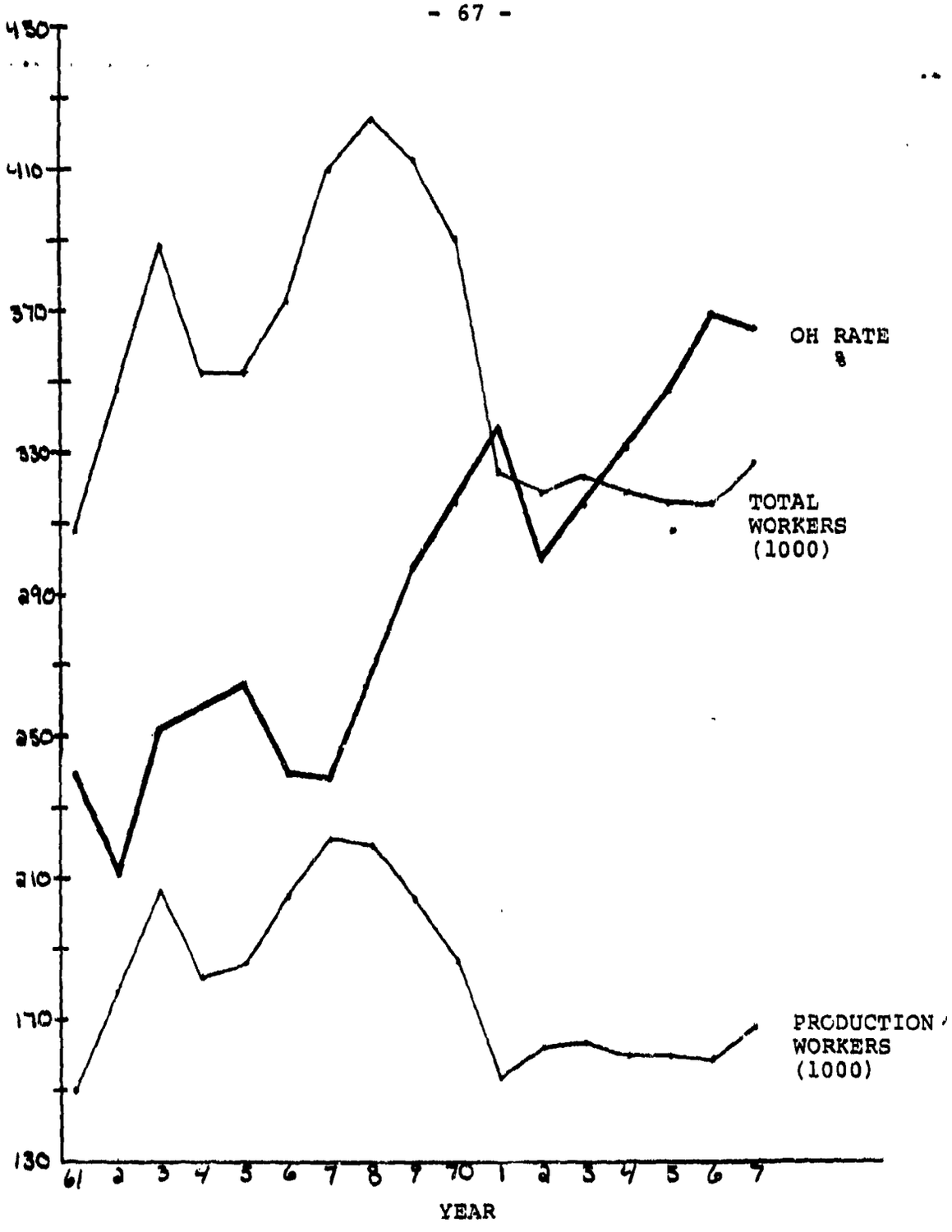


EXHIBIT XIV

WORKERS AND OVERHEAD RATE

RADIO/TV, COMMUNICATION EQUIPMENT

SIC 3662

1961-1977

EXHIBIT XV

U.S. RADIO/T.V. AND COMMUNICATION EQUIPMENT INDUSTRY: SIC 3662

SALES, EMPLOYMENT, PRODUCTION WORKERS AS A % OF TOTAL WORKERS

1961 - 1979

Year	Sales ($ million)	Employment (000)	Production Line Workers as a Percent of the Total Labor Force
1961	5,683	308	48.7
1962	6,664	348	51.1
1963	7,146	387	53.2
1964	6,510	352	51.6
1965	6,962	353	52.7
1966	7,563	373	55.0
1967	8,556	410	53.9
1968	9,560	424	51.7
1969	9,653	413	49.4
1970	9,299	390	47.7
1971	8,750	325	47.4
1972	9,140	319	50.8
1973	9,726	323	50.5
1974	10,575	319	50.2
1975	11,911	316	50.6
1976	13,248	316	50.3
1977	14,540	327	51.4
1978[1]	16,080	370	48.9
1979[1]	18,100	398	49.0

SOURCE: U.S. Department of Commerce, Bureau of the Census

[1]Estimated

EXHIBIT XVI

U.S. AIRCRAFT INDUSTRY - SIC 3721

PRODUCTION WORKER DATA

1961 - 1977

Year	Payroll Per Production Worker ($)	Overhead Per Production Worker ($)	Loaded Wage Per Production Worker ($)
1961	5,919	11,694	17,613
1962	6,283	12,406	18,689
1963	6,569	14,647	21,216
1964	7,631	14,006	21,637
1965	6,797	14,895	21,692
1966	7,311	19,359	26,670
1967	7,823	15,753	23,576
1968	7,829	18,809	26,638
1969	8,300	21,682	29,982
1970	9,359	24,565	33,924
1971	9,578	29,016	38,594
1972	10,168	26,137	36,305
1973	10,529	32,703	43,232
1974	11,281	35,345	46,626
1975	12,787	42,967	55,754
1976	14,078	49,008	63,086
1977	14,832	53,160	67,992

SOURCE: Based on U.S. Department of Commerce data.

EXHIBIT XVII

U.S. RADIO/T.V. AND COMMUNICATIONS EQUIPMENT INDUSTRY -
SIC 3662
PRODUCTION WORKER DATA
1961 - 1977

Year	Payroll Per Production Worker ($)	Overhead Per Production Worker ($)	Loaded Wage Per Production Worker ($)
1961	6,109	14,584	20,693
1962	6,787	14,359	21,146
1963	5,976	15,009	20,985
1964	6,429	16,604	23,033
1965	6,339	16,747	23,086
1966	6,517	15,585	22,102
1967	6,860	16,321	23,181
1968	7,233	19,466	26,699
1969	7,598	22,623	30,221
1970	7,806	24,672	32,478
1971	8,435	28,390	36,825
1972	8,938	26,877	35,815
197[illegible]	9,233	29,111	38,344
1974	9,769	32,281	47,050
1975	10,469	36,344	46,813
1976	11,409	42,069	53,478
1977	12,179	44,405	56,584

SOURCE: Based on U.S. Department of Commerce data.

EXHIBIT XVIII

U.S. AIRCRAFT INDUSTRY - SIC 3721
TOTAL RESOURCES PER PRODUCTION WORKER
1961 - 1977

Year	Payroll per Product. Worker ($)	Cost of Material per Product. Worker ($)	Overhead Cost Per Product. Worker ($)	Loaded Wage Plus Materials Cost per Product. Worker ($)
1961	5,919	17,069	11,694	34,682
1962	6,283	15,789	12,406	34,478
1963	6,569	16,611	14,646	37,826
1964	7,631	19,513	14,006	41,150
1965	6,797	19,884	14,895	41,576
1966	7,311	16,392	19,359	43,062
1967	7,823	24,385	15,753	47,961
1968	7,829	26,264	18,809	52,902
1969	8,300	25,821	21,682	55,803
1970	9,359	30,759	24,564	64,632
1971	9,578	34,164	29,016	72,758
1972	10,168	30,710	26,137	67,015
1973	10,529	34,058	32,703	77,290
1974	11,281	37,295	35,345	83,921
1975	12,787	47,066	42,967	102,820
1976	14,078	52,603	49,009	115,690
1977	14,832	56,664	53,159	124,655

SOURCE: Based on U.S. Department of Commerce data.

EXHIBIT XIX

U.S. RADIO, T.V. AND COMMUNICATION EQUIPMENT INDUSTRY - SIC 3662
TOTAL RESOURCES PER PRODUCTION WORKER
1961 - 1977

Year	Payroll per Product. Worker ($)	Cost of Material per Product. Worker ($)	Overhead Cost Per Product. Worker ($)	Loaded Wage Plus Materials Cost per Product. Worker ($)
1961	6,107	17,193	14,587	37,887
1962	6,787	16,292	14,359	37,438
1963	5,976	13,704	15,009	34,689
1964	6,429	12,736	16,604	35,769
1965	6,339	13,806	16,747	36,892
1966	6,517	14,790	15,586	36,893
1967	6,860	15,534	16,321	38,715
1968	7,233	16,954	19,466	43,653
1969	7,598	17,098	22,623	47,319
1970	7,806	17,516	24,673	49,995
1971	8,435	19,994	28,389	56,818
1972	8,938	20,605	26,877	56,420
1973	9,233	21,325	29,111	59,669
1974	9,769	24,044	32,281	66,094
1975	10,469	27,631	36,344	74,444
1976	11,409	29,843	42,069	83,321
1977	12,179	29,964	44,405	86,548

SOURCE: Based on U.S. Department of Commerce data.

EXHIBIT XX

WAGE PAYMENTS AS A % OF SALES - SIC 3662, SIC 3721

1961 - 1977

	ELECTRONICS SIC 3662			AIRCRAFT SIC 3721		
Year	Direct Labor	Indirect Labor	Total Labor	Direct Labor	Indirect Labor	Total Labor
1961	16	22	38	17	20	37
1962	18	21	39	18	22	40
1963	17	23	40	17	20	38
1964	18	23	41	19	17	35
1965	17	24	41	16	19	35
1966	18	23	41	17	19	36
1967	18	24	42	16	16	32
1968	17	24	40	15	15	30
1969	16	25	41	15	18	33
1970	16	25	41	15	17	32
1971	15	25	40	13	16	29
1972	16	23	39	15	18	33
1973	16	23	39	14	15	29
1974	15	22	37	13	15	28
1975	14	22	36	12	15	27
1976	14	21	35	12	14	27
1977	14	21	35	12	15	27

EXHIBIT XXI

PRODUCTION WORKERS/TOTAL LABOR FORCE
SIC 3662, SIC 3721
1961 - 1977

Year	AIRCRAFT SIC 3721	ELECTRONICS SIC 3662
1961	57	49
1962	55	51
1963	55	53
1964	56	52
1965	58	53
1966	59	55
1967	60	54
1968	59	52
1969	56	49
1970	53	49
1971	54	47
1972	57	51
1973	58	51
1974	58	50
1975	56	51
1976	56	50
1977	53	51
1978[1]	61	49
1979[1]	60	49

[1]Estimated

SOURCE: Based on U.S. Department of Commerce data.

EXHIBIT XXII

MATERIAL COSTS AS A % OF SALES
SIC 3662, SIC 3721
1961 - 1977

Year	AIRCRAFT SIC 3721	ELECTRONICS SIC 3662
1961	49	45
1962	46	44
1963	44	40
1964	47	36
1965	48	37
1966	38	40
1967	51	40
1968	50	39
1969	46	36
1970	48	35
1971	47	35
1972	46	37
1973	44	36
1974	44	36
1975	46	37
1976	45	36
1977	46	35

SOURCE: Based on U.S. Department of Commerce data.

EXHIBIT XXIII

SALES
SIC 3662, SIC 3721
1961 - 1979

($ millions)

Year	ELECTRONICS SIC 3662	AIRCRAFT SIC 3721
1961	5,683	6,000
1962	6,664	6,206
1963	7,146	6,317
1964	6,510	6,584
1965	6,862	7,151
1966	7,563	9,000
1967	8,556	11,079
1968	9,560	13,014
1969	9,653	12,444
1970	9,2[illegible]	10,996
1971	8,7[illegible]	9,313
1972	9,140	8,779
1973	9,726	10,666
1974	10,575	11,665
1975	11,911	12,544
1976	13,248	13,420
1977	14,540	14,834
1978[1]	16,080	19,630
1979[1]	18,150	28,000

SOURCE: U.S. Department of Commerce

[1]Estimated

CHAPTER III: CASE STUDY

NOTE

This case analysis was prepared primarily from the focus of the military Program Manager and his superiors in the acquisition community in order to illustrate the effect on total unit cost of changes in some of the variables impacting on unit overhead costs. Many of these costs are the result of quantity/quality decisions made either at the "user" level or otherwise mandated by Congressional appropriation and authorization procedures. Because of this, many of the costs for which the Program Manager is otherwise responsible are not in fact controllable by him; he must simply respond to them by adjusting his overall program budget to meet the required changes. Some of the costs are, however, potentially controllable or at least susceptible to influence by the Program Manager, e.g., proposed labor rates, proposed overhead rates. The case then is designed to illustrate those cost factors whose outcome he can hope to influence, and those that he cannot. Further, the case is designed to illustrate the need for a financial management scheme that tracks actively the effect of those actions that may have a major impact on total program cost and total unit cost.

This case, however, is <u>not</u> designed to present illustrations of either effective or ineffective handling of administrative problems.

* * * *

CASE STUDY

In order to illustrate the impact of the costs of an underutilized industrial facility on such factors as total program cost and unit overhead costs, data on a major military acquisition program was gathered and analyzed.

Specifically, data on costs of maintaining a high-technology, strategically important manufacturing facility was analyzed. The production rate for key military equipment in this plant is scheduled to decrease between 1979 and 1983 because of the phase out of a major acquisition program. Because of this, management was asked to forecast future labor and overhead rates for review by the relevant military department.

Because the facility is an important one strategically, management was requested to provide data on the costs that would be incurred were it possible to maintain the full capability of the facility irrespective of the number of units of military equipment that it produced. The data presented here indicates the planned decrease in output from 13.3 "units" of output in 1979 to 7.2 "units" of output in 1982 and 1983. In keeping with the main object of this project, the data shows the increased unit cost resulting from a fewer number of units of output absorbing an overhead base that initially, at least, is predicted to remain constant. In other words, the analysis is designed to present data on the cost of maintaining the full capability of the facility, in order to insure surge capability if and when this capability is ever needed. The request to management for this data, however, did not imply that a decision would be made by the relevant military department to maintain the full capacity of the plant.

In order to protect the confidentiality of the data, the figures in the various exhibits have been appropriately disguised. However, Company XYZ is a real company and product ABC is a real product. Although the financial data have been disguised, the outcomes they portray are consistent with the actual data analyzed during this project.

Table One contains the basic data available for analysis. Direct labor rates are shown increasing from $7.99/hour in 1979 to $12.94/hour in 1983. The wage adjustments were estimated by the contractor for forward pricing purposes based on the trend in wage scales in the area in which the plant is sited. The overhead rate was similarly estimated by the contractor. The assumption underlying the predicted overhead rate is that the overall capability of the facility would be held intact during a period of time when production decreased steadily due to a lack of demand for the firm's products. As shown in Table One, the overhead rates are predicted to increase from 233 percent of direct labor costs in 1979 to 361 percent in 1983. As a result of the increase both in overhead rates and in the base wage rates, the overhead rate per hour per production line worker is then predicted to increase from $18.62 in 1979 to $46.71 in 1983. Put another way, the total cost of maintaining a production line worker, apart from the materials consumed by the production line process, increases from slightly more than $26.00 per hour in 1979 to almost $60.00 in 1983. This is due (a) to the proposed cutback in production while (b) holding plant capability constant.

As shown in Table Two, the total manhours of direct labor needed per year to produce the required military system are reduced from slightly less than 3.1 million man hours to slightly more than 1.6 million man hours. In

other words, direct labor hours per unit of output remain constant. Because the analysis assumes that the plant will be kept in full operating condition, overhead costs rise disproportionately reflecting (1) the steady inflation-driven increases in costs in our general economy coupled with (2) the anticipated costs of maintaining a corporate capability irrespective of levels of throughput. The temporary dip in overhead costs in 1982 is due to a reduction in those overhead costs such as fringe benefits that vary directly with direct labor costs. These temporary savings, however, are overtaken by a massive increase in costs in 1983. Despite the drag in total overhead costs from 1981 to 1982, overhead costs per man hour of direct labor continue to increase from 1981 to 1982, e.g., from $31.15/hour to $35.89/hour.

The full dollar cost impact of the reduction in throughput holding plant capacity constant can be seen in Table Two. Overhead costs per unit of output increase from $4.2 million/unit in 1979 to $10.6 million/unit in 1983 although the products produced in each of these years are "Chinese copies" of each other. The predicted changes in overhead costs per unit thus do not represent any change in product design, technology or complexity. Rather, they are due solely to a combination of inflationary pressures and the projected underutilization of plant capacity. Were this plan to be followed, our estimates would show that inflation accounted for approximately $1,500,000 of the $6,400,000 increase in costs between 1979 and 1983 whereas the cost of the underutilization of the plant's full capacity would account for some $4,900,000/unit.

Table Three presents derived data on the total unit cost of the system for other than raw material which historically has accounted for only 20 percent of the final

product cost. As shown in Table Three, labor and overhead related costs per unit more than double in five years, i.e., from $6.1 million to $13.6 million with the greater portion of the increase due not to direct labor but, rather, to overhead factors or, in the terms used in the body of this report, the cost of maintaining corporate or institutional capabilities.

For contrast, Table Four presents derived data on the overhead cost per hour and final unit cost if output is maintained at the 13.3 unit per year base. By 1983, the cost of maintaining corporate capability on a lower level of physical output would be approximately $4,900,000/unit of output. By 1984 or 1985, then, it would be possible to virtually double the planned output of product ABC at no cost to the military department other than incremental cost of the raw material used in the manufacturing process.

In order to put the dimension of the "problem" into its proper perspective, we reviewed the total program cost for the major weapon system into which Product ABC is integrated. Indexes of total Program Cost and the cost of products such as ABC are shown in Table Five. As shown here, the major cost push in this program is the result of the rapid increase in the cost of products such as ABC. These increased costs are due to the costs of the current need to maintain low production rates in facilities that cannot now be fully utilized. It is this type of cost structure that often times distorts an analysis of the perceived cost of a major weapon system and, in so doing, creates reductions in unit buys which in turn create unanticipated changes in force structure. This suggests the need to constantly review the potential cost of an underutilized facility as was done in this analysis in order to be able to minimize the need for paying for capabilities that may not be properly utilized.

TABLE ONE: DIRECT LABOR, OVERHEAD RATES, THE XYZ COMPANY

YEAR	DIRECT LABOR RATE/HOUR	OVERHEAD RATE	OVERHEAD/HOUR	LOADED DIRECT WAGE PERHOUR
1979	$7.99	233%	$18.62	$26.61
1980	9.04	260%	23.50	32.54
1981	10.28	303%	31.15	41.43
1982	11.43	314%	35.89	47.32
1983	12.94	361%	46.71	59.65
PERCENT INCREASE				
1979-1983	62.0%		150.9%	124.2%

TABLE TWO: SCHEDULED MAN HOURS OF OUTPUT, THE ABC PRODUCT, THE XYZ COMPANY

YEAR	SCHEDULED MAN HOURS OF DIRECT LABOR	OVERHEAD RATE/HOUR	TOTAL OVERHEAD ABSORBED
1979	3,092,000	$18.27	$56,490,840
1980	2,967,000	23.50	69,724,500
1981	2,243,000	31.15	69,869,450
1982	1,635,000	35.89	58,680,150
1983	1,635,000	46.71	76,370,850

	UNIT OUTPUT	OVERHEAD PER UNIT OF OUTPUT
1979	13.3	$4,247,432
1980	13.3	5,242,444
1981	9.9	7,057,520
1982	7.2	8,150,020
1983	7.2	10,607,063

TABLE THREE: UNIT LABOR, UNIT OVERHEAD, TOTAL LABOR AND OVERHEAD COST, THE ABC PRODUCT, THE XYZ COMPANY.

YEAR	DIRECT LABOR COST PER UNIT (0000)	OVERHEAD COST PER UNIT (0000)	TOTAL LABOR AND OVERHEAD COST PER UNIT (0000)
1979	$1,857,525	$4,247,432	$6,104,957
1980	2,016,668	5,242,444	7,259,112
1981	2,329,095	7,057,520	9,386,615
1982	2,595,563	8,150,021	10,745,584
1983	2,938,458	10,607,062	13,545,520
PERCENT INCREASE			
1979-1983	58%	150%	122%

TABLE FOUR: UNIT COST, THE XYZ COMPANY, ABC PRODUCT BASED ON CURRENT PRODUCTION PLAN AND ON HOLDING OUTPUT CONSTANT AT 13.3 UNIT OUTPUT PER YEAR

YEAR	DIRECT LABOR PER HOUR	OVERHEAD PER HOUR/CONSTANT THROUGHPUT[1]	UNIT COST BASED ON CONSTANT THROUGHPUT[2]	UNIT COST, BASED ON REDUCED THROUGHPUT
1979	$7.99	$18.27	$6081	$6081
1980	9.04	22.55	7332	7341
1981	10.28	22.60	7644	9443
1982	11.43	18.98	7070	10801
1983	12.94	24.70	8751	13610

[1]These calculations assume a constant level of 3,092,000 scheduled man-hours of direct labor.

[2]These calculations assume that total overhead absorbed is independent of the level of scheduled man-hours of direct labor. We realize that this assumption is a simplification of "real world" situations, and so may understate the unit cost based on constant throughput. However, our method of calculations enables us to establish <u>trends</u> in the behavior of unit costs, which is our purpose here.

TABLE FIVE: INDEXES OF COST, TOTAL SYSTEM COST, AND PRODUCT ABC AND SIMILAR PRODUCTS

YEAR[1]	TOTAL SYSTEM	PRODUCT ABC*
1979	100	100
1981	122	169

*Plus similar products, e.g. components.

[1]Total program costs are indexed for 1979 and 1981 only. These figures do not reflect the rapid increase in costs which take place after 1981.

CHAPTER IV: ESSAYS ON OVERHEAD

A. POLICY AND ADMINISTRATIVE IMPLICATIONS

In an attempt to gain perspectives on the "overhead problem" as it has been portrayed in this project, it would appear necessary to distinguish between the political vs. the economic implications of this type of analysis. In our opinion, no economic system can be analyzed apart from the political structure in which it is imbedded. This is not simply a case of relating ideology to an underlying economic system. The perspective of the political system must include not only an analysis of the ideology and the "rules of behavior" established by that ideology but, perhaps more importantly, an analysis of the institutional structure that has developed around that ideology. The system of governance and the bureaucracy, whether in the government, in the academic community, or in the large corporation must also be considered since it is these communities which interpret the underlying condition of the economy and from their perspective determine whether a problem exists, whether it is worthy of solution, and then act or fail to act to solve the underlying problem or conflict. In a sense, there are no problems if the various opinion and decision-making bodies fail to define them, and no solutions if they elect not to pursue them.

Put another way, economic efficiency is not an absolute; it is a variable whose definition is based on a set of values which weigh among others sociological, political, military and economic considerations. The relative weight accorded the different value-laden inputs will then prescribe a time-related, acceptable view of economic efficiency.

An example at the policy level might well illustrate the problem. Based on our evidence, much can be said of the virtue of economic concentration especially in our defense related industries if by economic efficiency we mean a least cost solution to an output (production) problem. From the very narrow, self-centered perspective of economic efficiency as measured by the buyer, it is reasonably evident that the Department of Defense would be well served to concentrate its extremely limited purchases of fixed wing military aircraft in as limited a number of firms as is possible. Given our current requirements, one producer could easily produce our annual needs of approximately 300 fixed wing aircraft per year. Doing so could lead to savings of as much as $1,000,000,000 per year provided only that the government could circumscribe effectively the monopoly power that this concentration of industrial power might create. This legal authority is well within the current purview of the government.

However, economic concentration is regarded as dysfunctional in the United States because of our potentially unsubstantiated belief that 1) competition per se leads to lower prices; and 2) lower prices, given the notion of consumer sovereignty and consumer choice, maximize the utility and hence economic freedom of the consumer.

Further agitating against a governmental policy that would allow a number of aircraft firms to fail or otherwise go out of business is the government's concern with overall employment levels in the economy. Defense aerospace jobs would be lost. Given the nature of commercial demand for aircraft, and the growing capability of the European and Japanese aerospace industry, it is unlikely that the U.S. civilian aerospace sector could absorb the

unemployment created by this concentration effort. In other words, the economic price paid for concentrating employment and output in the industry would be at least the temporary and possibly the permanent unemployment of as many as 100,000 persons. Economic efficiency, then, is a two edged sword. Pareto to the contrary, for someone to receive a benefit, someone must pay the price. This, then, is probably the greatest impediment to the economic rationalization of an industrial base that today suffers from redundant capacity. Because of the magnitude of the problem, it cannot be solved by the military acquisition community alone. Instead, it is a Congressional and Executive level policy and administrative problem since pursuing a policy which leads to economic concentration in one segment of our economy may well establish the precedent for doing so in a multiplicity of areas. To do so, politically at least, would require that we restructure our thinking on the relationship between economic concentration, economic power, and economic freedom.

However, much of the data presented in this study speaks to the need for a more complete utilization of existing industrial capability or, lacking the ability to stimulate these higher rates, the political willingness to allow segments of an industry to close down. This is, as noted, antithetical to our traditional modes of thought despite the fact that, in so doing, we might, on one hand, serve to constrain some of the inflationary pressures in our economy while, on the other hand, release capital for investment in the growing segments of our economy. This potential has never been explored by the American economic and polical community despite the somewhat obvious need to do so.

Here it should be noted that this type of rethinking through of basic principles could and most likely should be confined to our defense industrial base for this is the one market where (1) the government is the key if not the sole buyer and (2) where the interrelationship between military strength and economic viability is most evident. Ultimately, supporting a redundant industrial capacity leads to ever increasing and artificially higher prices. Where these high prices do not create a ripple effect in our economy, or where these higher prices do not serve to drastically limit the size of the force structure that we can deploy, they are, in the sense discussed earlier, a non-problem.

However, based on analyses outside the scope of this report we appear to have crossed over the line with respect to our inherent ability to deploy sufficient amounts of (conventional) military equipment to meet the military and geopolitical threat defined in these other analyses. From the very limited perspective of this study then, it appears that we have paid a price for failing to pursue an economic policy based on a more demanding view of industrial efficiency.

Here it should be noted that we do not subscribe to the thesis advanced by Melman and others that military production is, by itself, economically inefficient if not downright wasteful. Our analyses would simply suggest that the industrial and bureaucratic structures that we have created to manage the defense industrial structures have not been allowed, for a broad range of political, sociological and <u>other</u> economic reasons, to be as efficient as they might otherwise be. Other national goals preempt the need for a narrowly defined view of economic efficiency

within a relatively small subset of our overall economy. That is the most that can be said of the acquisition system apart from some ideological concern which would lead either to praiseworthy statements or outright condemnation of our defense industrial base.

The ripple effect of our institutional failure to reach for high levels of economies of scale and other productive efficiencies can be seen, in our opinion, in an analysis of the subcontracting system which has grown up in the defense industrial base. Large primes receive substantial credit during the Source Selection Process for subcontracting as large a portion as possible of their ultimate output with small firms and other firms which, for various reasons, cannot compete with the large firms for contracts. In this context, the defense acquisition process takes on a socio-economic cast; designed, through the medium of a "make-buy" decision to maximize the ripple effect in our economy of the defense budget. Industrial efficiency becomes secondary to the more often subtle goal of social efficiency. The explicit criterion for the "make or buy" decision. . .do the job where it is cheaper to do it. . .becomes muted. Although we cannot and possibly should not quarrel with the transcendental value of political efficiency, it is still valid to analyze the impact of the substitution of political for economic criteria.

The net effect for many defense contractors is to move them towards a high cost assembly form of industrial structure and away from the more classical production oriented industrial structure. Put another way, under the political requirement for extensive subcontracting, the <u>entire</u> industrial structure moves more towards a horizontal

as opposed to vertical form of organization. However, this can create cost efficiency problems in that horizontal organizations, and especially those that rely heavily upon extensive networks of separate corporations, require that the larger number of firms in the chain each be kept economically viable. In terms of this analysis, extensive subcontracting procedures driven by the economics of low rates of production, require ever increasing sums of money to be spent in the overhead account in order to maintain the aggregate corporate capability needed to lead to the final assembly of a product.

In theory at least, the properly organized, vertically structured firm could minimize overall production costs subject only to the constraint that the firm have sufficient throughput for it to justify the acquisition and use of production-oriented capital equipment. This is not possible today because of a series of non-economic imperatives not the least of which is to spread the Federal dollar over as large an industrial base as is possible. This is, of course, a form of social efficiency that is contrary to the generally accepted concept of economic efficiency.

We have, then, in a sense come full circle. Given the current state of economy and any reasonable prognosis for the predictable future (1-10 years), one form of economic rationality would call for the elimination of much of the current redundancy in our defense industrial base, i.e., a greater concentration of throughput as a way of gaining economies of scale and other efficiencies in production.

For all of the obvious reasons, i.e., political efficiency, impact on employment, the potential (but not proven) impact on surge capacity, the potential disruption of the

propensity to invest in policies and programs designed to bring about technological changes and innovation, the underlying thrust of our defense industrial policy has not been to require the form of industrial structure required by a least-cost solution to an acquisition program. Concentration of economic power, then, is anathema to American economic policy although we have, in fact, allowed certain of our industries, e.g., the utilities, to so concentrate their powers as to become monopolies.

This would suggest, parenthetically, that our application of economic theory to economic reality is not bound by a need for complete consistency; that we do in fact believe that there are (1) specific virtues that go with the concentration of economic power and (2) that the faults of this economic power can be cured by government regulations. Ours is not a one-sided economy in this sense which would thus suggest that there is a framework within our political-economic thinking that does allow for the properly controlled concentration of economic power. There is nothing in economic theory or practice which would suggest that this same framework could not be applied to distinct elements of our defense industrial base if all other requirements of economic and political freedom and equity were met.

The fact is, based on analysis of our data, we have allowed much of our defense industrial base to develop a price/cost structure which, however efficient politically, is now a major impediment to the building of the force structures required by a more current view of the military threat facing us.

B. MILITARY CONSIDERATIONS

The unmistakable manifestation of the inability of the defense industrial sector to attain reasonable levels of economic efficiency is a rapid runup in the unit cost of major weapon system. Given the complex nature of most major weapon systems, i.e., the fact that they are compsed of a market basket of goods produced by a multiplicity of industries many of which operate well below normal capacity, the ultimate increase in cost is apt to be far greater than the sum of the parts.

As prices increase and as Congress attempts to manage defense efforts through the medium of a total expenditure constraint as opposed to a unit cost concept, the normal outcome of an increase in cost is a reduction in the number of units purchased or, in military terms, an ultimate reduction in the size of the deployable force structure. This effect is most likely enhanced because the rate of price increase in major military systems has been greater than that experienced in the economy as a whole.

The reduction in units purchased, in turn, creates an economic dilemma. As unit price increases, unit buys decrease. But as unit buys decrease, unit price increases. The proverbial "chicken and egg" routine develops in which one price increase induces yet another.

Further and more important than the economic consideration, is the induced need to increase the military effectiveness of the fewer units of military equipment that are made available to the military services. High cost additions and/or modifications to equipment are needed to provide the force multipliers necessary to offset the disadvantage of limited quantities

of military equipment. Because of their cost and complexity, and the fact that they in turn are produced in less than optimal quantities, another cost push is added to the ultimate price of a highly technical major weapon system. Absent a substantial increase in budget, further reductions in the size of a deployable force structure can then be anticipated.

The economic mechanism that drives this inherent reality is the overhead structure of the firms participating in the defense acquisition process. To the extent that competitive forces exist only at the margin, and to the extent that overhead costs can be controlled only minimally in an environment characterized by low levels of output, an adaptive process takes over. In Parkinsonian terms, costs will increase to the point where they absorb the available funds. Ultimately, both economic and military efficiency and effectiveness are sacrificed.

C. OVERHEAD COSTS AND CORPORATE PERPETUITY

Most discussions of overhead costs assume that they are fixed. That is to say, that they do not vary directly with sales or output. Thus, as a company's sales increase, its overhead rate should decrease as a fixed number of overhead dollars are spread over a greater number of units of output.

The underlying dynamic here is relatively simple. Most costs traditionally categorized as overhead do not vary with sales. Depreciation expense, the cost of long term borrowings, executive and administrative salaries, equipment rentals and leases, and a broad range of other costs are not responsive to short run changes in the business base. Once incurred, they must be endured and recovered, if at all possible, in overall long term pricing practices. Clearly, a corporate catastrophe can eliminate some of these costs. However, in the normal course of business a heavy portion of overhead costs is in fact resistant to change. Because of this, overhead rates should be expected to vary with unit output both in the short run, and in the long run. Overhead rates, all other things being equal, should be representative of capacity utilization rates within an industry.

Based on our data, however, overhead rates do not now appear to be as responsive to long-term changes in the business base as might otherwise be expected. The long-term trend in overhead rates during the seventeen year period reviewed in this study is skewed upwards. There are, we believe, a number of explanations for this. Overhead costs may, for example, have simply been overwhelmed by the high rates of inflation recorded in our

economy these past few years such that there is very little that management can do, short of a major restructuring of the entire firm, to counter this trend. In other words, the "cost of doing business" may have increased more rapidly than anticipated. For the more recent past, there is some evidence available to support this hypothesis. However, as is intuitively obvious, there is an outer bound to which management can raise prices, a point after which consumer demand can be expected to drop precipitously enough to require a restructuring not of the individual firm but of the industry. This may have already happened in a number of industries that have been, or are in the process of being, overwhelmed by foreign competition. If this is so, then we clearly need to know where else it is apt to happen in our economy and especially so if it impacts on our strategically important defense industrial base.

A more likely hypothesis for the apparent failure in recent years of overhead rates to be more responsive to changes in the business base may be found, we believe, in an exploration of the relationships between overhead costs and corporate capability and perpetuity.

In point of fact, a reasonably substantial proportion of the costs incurred by a corporation and subsequently classified as overhead are related not to the direct maintenance of unit output but to the intrinsic capabilities that management believes the corporation must maintain in order to stay in business. Some portion of the costs classified as overhead are in fact investments for the future. Expenditures for plant and equipment are the prototypical example of capability-maintaining expenditures whose long-term implications show up in various overhead

accounts. Similarly, the maintenance of design and engineering staff, layers of executive and middle management personnel, and a range of other related functions are examples of areas where corporate management must, in fact, be prepared to maintain a relatively fixed level of expenditures irrespective of current production levels. A corporation that wants to maintain its marketing position and hence remain in business must be prepared to pay the cost of maintaining a large enough base of operations to keep it satisfactorily insulated from overly destructive competitive forces and guarantee it some possibilities for economies of scale. Those funds used for these purposes are in fact capability and perpetuity related regardless of how they are categorized for accounting purposes. They are part and parcel of the overhead costs absorbed over time by the firm's customers.

The central industrial and economic issue, then, is the willingness and/or ability of the marketplace to pay these increased costs. Since higher prices, whether created by increases in labor, material, or overhead, may dampen demand, and since a reduction in demand may in turn lead to reduced unit output and hence increase unit overhead costs disproportionately, there is a circularity in the cause and effect relationships that is difficult to break. In a non-inflationary economy, actions which increase demand and, in so doing, precipitate economies of scale in vital industries, clearly lead to decreasing unit overhead costs which may allow cost savings to be passed on to the consumer. As is obvious, the same solution may be inapplicable in an inflation ridden economy or within an industry that must of necessity be sustained by its customers irrespective of the levels of output that the customer demands of it. In this latter instance,

the customer must be prepared to pay all of the overhead costs needed to maintain corporate capability and perpetuity. There is no other alternative.

Much of the U.S. defense industrial base fits this model as do particular segments of the utility industry. For competitive reasons in the defense industry, and for capacity related reasons in the utility industry, either virtually all of the capabilities of the individual firm or none needs to be maintained. Given corporate dynamics, the behavior of the marketplace, and a range of industrial and economic factors that are apparently not yet understood in their entirety, maintaining a middle ground appears to be difficult if not impossible. The equilibrating mechanism for maintaining the complete business unit then becomes the level of payments made for overhead costs; some of which are related and some of which are not related to current levels of output. In a broader context, overhead costs may be viewed either as the social or political cost incurred in the maintenance of an industry essential to the segment of the consumer market that it serves, or as an "economic bribe."

The bribe need not be overt in the sense of the consumer being acutely aware of the increased price he is paying for a product. The cost can be hidden by a general inflationary trend within an economy where the psychological perception of price and value (or utility) is confused such that the demand for a product is considered to be price inelastic, when in fact the opposite is true. In other words, the consumer would not in fact pay the price were he able to better relate it to a price that he might pay in a stable economy. This is by way of saying that consumer knowledge is made imperfect by disparate rates of inflation in a

broadly inflationary economy and the consumer thus has a very limited basis for making informed econo c judgments. A range of products or services may then becom more price inelastic than otherwise might obtain thus allowing the industrial sector to pass along all cost increases plus a margin for corporate slack.

The more general economic risk here is that the market clearing price estimated by management may be made high enough to induce a precipitate drop in demand rather than the gradual one anticipated by most economic theories. For those products susceptible to foreign competition, the precipitate drop in demand for the domestically manufactured product can be sufficient enough to destroy an industry within a relatively brief period of time. In a laissez-faire market-oriented economy such as our own where the government does not participate in the formulation of an economic or financial strategy for the corporate sector, the risk of foreign intervention is heightened.

Although outwardly contradictory, we would allege that it is the laissez-fair attitude of the government that requires it to intervene in the marketplace for those goods and services which are essential to its survival, e.g., the products of the defense industry. Here the government must be prepared to protect the marketplace by absorbing enough corporate overhead costs to guarantee corporate perpetuity, and generally at a level sufficient enough to retain the long term interests of both management and labor.

The more important point, however, is that the federal government, by its failure to enunciate an industrially oriented financial and economic policy, denies itself

the subsequent ability to promote otherwise essential forms of industrial rationalization. The ultimate cost of this failure may well be the maintenance of a highly redundant, less self-sufficient defense industrial base than might otherwise obtain. The actual cost of this failure, based on our statistics, is absorbed for the most part in the overhead accounts which have now become less than fully responsive to changes in the business base.

D. OVERHEAD RATES AND ECONOMIES OF SCALE

As suggested earlier, in the short run, overhead costs and rates should be responsive to changes in the business base. Overhead rates should vary inversely with changes in sales volume. The economic concept of economies of scale and productivity are fashioned in part on the supposed existence of this relationship. Intriguingly enough, our data do not do olence to these concepts if relatively short periods (one to three years) are observed. It is the long term trends which do not follow accepted theory suggesting that our industrial economy may no longer be organized in a way in which a firm can reap substantial gains either from productivity increases or economies of scale.

Three explanations are possible here:

1. That all costs are or have become more variable than otherwise anticipated. Indeed, our data would suggest that all costs are variable in the long run, and that many are more variable in the short run than is assumed by conventional accounting and cost theory.

2. That the magnitude of the diseconomies of scale may be greater than anticipated; that the cost of failing to operate near capacity level may be greater than anticipated by conventional industrial engineering analysis and that these diseconomies can be overcome only by extremely high levels of output.

3. As a corollary to (2) above, that significant elements of the U.S. industrial base may have reorganized themselves away from the prototypical vertically oriented manufacturing form of industrial structure and more towards an assembly form of operation. The assembly form of business operation would result from a heavier emphasis on the "buy" portion of a "make-buy" decision and be driven, at the corporate level, by (1) the need and/or desire to limit investments in non-liquid plant and equipment, (2) the marketplace's demand for a product whose technological complexity does not allow for the maintenance of highly integrated manufacturing firms, or (3) a combination of the two.

With respect to the variability of the alleged fixed costs, it should be recognized that the conventional accounting view of overhead includes an ever increasing number and quantity of costs that vary directly with production line employment. The most obvious of these are the so-called supplementary wage benefits: social security, health and accident insurance programs, paid holidays and vacations, and so forth. For some industries, these costs may now account for as much as 50 percent of the costs otherwise classified as overhead and, hence, conceptually regarded as fixed, i.e., spreadable over increased levels of output.

Increasing levels of employment in order to increase output in order to reduce unit overhead costs may, in these instances, lead to contrary results; namely, a proportionate increase in all costs and, thus, a failure

to attain more than minimal benefit from the so-called economies of scale.

This is most likely the situation extant in a shipbuilding industry which remains basically labor intensive. It may also be reflective of the situation in other industries where there is a reasonably direct and possibly one-to-one relationship between the need for production line and non-production line workers at all but extremely high levels of employment. Our data would suggest that the aircraft industry, as it is presently organized, fits into this model.

If this is so, then there is very little that the government can do, in the short run, to reduce market prices in either of these two defense oriented industries. In the long run, given the nature of shipbuilding, the best that the government can do is to provide workplace incentives which increase the efficiency of the production line worker. Because the industry is a low overhead industry, and because the bulk of the overhead costs are in fact labor related, it is unlikely that increasing the workload of the individual shipyard will do more than generate relatively minimal cost savings. Labor efficiency is the more relevant issue in this industry.

The aircraft industry, to the contrary, is a high overhead industry which would suggest that long run savings can be generated by increasing the industry's rate of throughput, i.e., spreading fixed overhead costs over a greater number of aircraft. This can be brought about by either increasing <u>substantially</u> the number of aircraft bought from the entire industry or concentrating government production in a fewer number of firms. Although production

line labor efficiency is a key factor for this industry, our data would suggest that greater benefits can be gained by attacking the overhead, or unit throughput factor, first.

Here a word of caution is essential. Our data would suggest that overhead spreading tactics will succeed at relatively high levels of output only; that marginal changes in throughput, e.g., an increase from two to four planes a month, or from ten to twelve, will have no perceivable effect on the industry. This is another way of saying that the diseconomies of scale in the industry may be greater than realized and that sharply increased rates of throughput may be needed before unit savings can be accomplished by virtue of the so-called economies of scale.

This last point is related ineffably to our earlier note on manufacturing versus assembly oriented industries. Any increase in unit output must be large enough and sustained for a long enough period of time to justify bringing in-house a number of operations now done by various subcontractors. Two points obtain here. The first is that unit demand must be large enough to justify even a partial shift from a labor intensive to a capital intensive form of operation. The second is that as much of this shift must be with the prime contractor in order to limit the multiple tiers of overhead and profit built into an assembly type of operation that relies for its existence on a broad range and extensive layering of subcontractors.

E. THE DEFENSE INDUSTRIES: A DISCUSSION

It is virtually axiomatic that the U.S. needs a large and stable aircraft industry. The military importance of the industry is reasonably obvious as is the major positive contribution made by the industry to our balance of payments. Also, the industry is a fairly substantial employer of skilled personnel.

The electronics industry similarly is a key employer of skilled personnel. Like the aircraft industry, it is a major component of our defense industrial base. In many ways, however, the industry may be more vital to our defense posture than even the aircraft industry per se because of its production of high technology, force-enhancing, mission-related equipment that is central to the qualitative edge that most U.S.-built military systems are believed to have over competing foreign systems. Because of this, it is obviously in the national interest to maintain both of these industries irrespective of their underlying cost structure. We need them economically and militarily.

From a purely economic point of view, both of these industries are operating well below their full capacity. This inherent industrial inefficiency is manifested in higher prices than might otherwise obtain were these two industries able to operate efficiently. In the theoretical world of Adam Smith, the "hidden hand" of price competition should long ago have led to pressures within the marketplace which forced a number of firms out of active participation in the two industries. Those that survived this intense price competition would then, if only in theory, have been able to gradually recapture a sufficiently large enough share of the market to pursue economies of scale and other production line efficiencies. These efficiencies,

in turn, would have exerted downward pressure on prices as competition for the remaining business intensified. In this "best of all possible worlds", a larger proportion of the sales dollar would once again be devoted to physical output with a decreased amount of dollars spent to maintain otherwise redundant corporate capability.

The potential for this outcome is, of course, based on the assumption that the marketplace is freely competitive; that there are no artificial barriers to enhanced competition.

Based on an analysis of the data on employment trends and overhead rates in these two industries, it is reasonably obvious that this highly competitive situation has not been allowed to obtain; that the full effect of price competition within these two industries has been muted by other forces. Here our analysis would suggest that political efficiency -- in this case, the militarily essential preservation of an otherwise redundant and high cost industrial base -- has had to take priority over economic efficiency. National interests have been deemed to be more important than economic efficiency.

The most cogent evidence of the political nature of the decision can be found in an analysis of the aircraft industry where no single firm today produces more than a handful of fixed wing military aircraft each year despite the obvious and persuasive data provided by prior programs on the impact on final cost of concentrating high levels of output in a very limited number of firms. As has been shown by other studies, we now pay an extremely high premium in unit costs for a policy that dictates the maintenance in the United States of seven militarily-oriented aircraft manufacturers. From an economic point of view, this decision

makes very little sense. This is especially so in a highly inflationary economy where a return to concentration might well serve to constrain price trends.

However, this is purely an economic argument. As is evident, there may be overriding military and political arguments for the maintenance of an otherwise redundant industrial base. If this is so, then the economic and military cost of this political policy needs to be more fully analyzed. Our analysis suggests that the artificially high prices required to maintain excess capacity in these two industries now serve to limit the size of the military force that the United States can deploy. In other words, there is a distinct and potentially measurable price elasticity of demand for military equipment. The higher the price, the fewer will be the quantity of a product demanded by the marketplace. This result will obtain whether it is the individual buying a consumer product or the Congress buying a "common good" such as military hardware. The reasoning may be more complex in the case of Congressional contemplations, but the evidence of reduced consumption is the same. Ultimately some form of economic efficiency obtains. Here, however, it should be noted, that economic efficiency is measured in terms of a total budgetary outlay and not unit cost. Our evidence would suggest that this is the incorrect economic criterion to be applied; that unit cost is the more relevant probative factor with which to be concerned.

F. THE DEFENSE ACQUISITION PROCESS AND CONGRESSIONAL BEHAVIOR

The basic purpose of any military acquisition program should be to provide our armed forces with the quantity and quality of military equipment that they need to protect our national interests. Our problem today with the process is that it has been allowed to become far too diffuse. The acquisition budget is used to promote social goals (employment levels), political goals (the return of federal funds to specific geographic areas), economic goals (the diffusion of funds out to a large number of small businesses), and scientific goals (the preservation of a defense industrial base). Because of this, the basically military character of the process, while not entirely subordinated, has become intertwined with a series of other relationships which may be irrelevant in terms of our current and projected ability to win a war should this need ever prevail.

Thus, any project which seeks to analyze the acquisition process in order to find ways to improve it must be willing to face up to the difficult reality that the stated goals of the process. . . and the goals that are actually pursued. . . have become divergent over time.

In many ways, this outcome should have been anticipated. The acquisition system, as with any other system, has evolved in response not only to differing views of the military threat but also to differing economic scenarios. Through the early 1960s, at minimum, U.S. military superiority over the Russians was undisputed. Because the Russians had not rebuilt their conventional military forces after WWII, and because we were still able to live off much of the asset base that we had acquired during and shortly after

WWII, our acquisition process could afford to be more technology than production oriented. Further, given our predisposition to rely heavily on strategic nuclear capabilities and our view of the threat we believed that we could afford to disassemble our network of arsenals and rely more heavily on a basically small and highly diffuse defense industrial base. From the legislative perspective, the acquisition system could then be adapted to provide for the requisite support of a smaller industrial base, especially in the technology development area. Given the reasonably small unit production of conventional equipment required to support a strategic nuclear capability, unit cost considerations could be somewhat de-emphasized.

As a selective consumer of military goods, the nation in the above scenario could afford to be somewhat less price sensitive than it might otherwise have been if masses of equipment were needed or desired. It seems relatively safe to say that the acquisition process ordered itself around this reality and the laws, rules, and regulations and oversight procedures followed from this ordering.

However, threats and economic realities change. It seems obvious now that we must once again rebuild much of our conventional military strength. However, because the costs of military equipment have increased more rapidly than anticipated and because there are other non-military economic strains in our economy, it seems evident that we need to rethink the acquisition process. Indeed, we may have to downplay the "process" itself which has taken on a life of its own, and concentrate on the central issue of the least-cost output of military hardware. Put another way, we may be at a point in time when we have to discard, if only temporarily, the more broadly based socio-economic,

political and structural concerns built into the defense acquisition process and move towards a more rapid and more abundant production of deployable equipment.

To do so, however, would require if not new Defense Acquisition Regulations then a more production oriented view of how the Department of Defense should deal with its industrial base. In this regard, we may have to relax procedures in order to provide industry with the flexibility that it needs to produce more economically. From a Congressional perspective, this may ultimately mean a more free flowing approach to the appropriation and authorization process. This would mean insisting that major programs once underway move as rapidly as possible to completion and be released, where relevant, from an annual appropriation and authorization cycle much as is done by some of our European allies. "Multi-year funding" is the term normally used to describe the acquisition procedure but even this term may not adequately describe the more broadly based outcome that is needed to move equipment through the acquisition cycle more rapidly than now obtains.

For example, one of the major problems impacting the military acquisition process is the more than occasional need to "stretch out" a program in order to remain within budgetary constraints. In general, this situation occurs when the initial appropriation for a program is found to be inadequate to maintain a desired production rate. In order to live within the budgetary constraint imposed on the program by Congress, and not impact or otherwise divert funds from one on-going acquisition program to another, unit throughput is decreased consistent with the funding then available to the program. By "losing sight" of the unit cost of the item being purchased, the effect of this

action is to make total (program) budget the independent variable in the acquisition process and unit cost the dependent variable.

This is not, of course, the way Congress has legislated the process. Congress in its deliberations invariably ties units of output to specific budgets through the authorization process. However, because of the annual funding process mandated by Congress, and other legitimate and proper limitations on the acquisition process as it is now organized, the one key technique available to the acquiring military department, when delays or disruptions or other problems are encountered in a major program, is to live within the budget by decreasing or delaying unit buys. This occurs despite the fact that, in general, a lower production rate increases unit cost inasmuch as there are fewer units over which to "spread" the relevant, capability maintaining overhead costs. This, in turn, creates the vicious cycle of upwardly spiralling weapon system costs which, seriatim, increases unit cost which decreases unit buy which increases unit cost. The ultimate impact on force structure is to reduce the quantities and availability of deployable systems despite the previously stated time related need for a specific quantity of equipment.

Thus, all efforts to the contrary, until such time as a technique is devised for appropriately discouraging the need to use the "stretch out" technique. . . or for providing the incremental funds needed to avoid a contingency of this type. . . the cost of military equipment will no doubt increase more rapidly than otherwise anticipated. Furthermore, force structure goals will not be attained in time necessitating temporary but expensive fixes which will further decrease the already limited sums

of money available for purchasing needed military equipment.

Congress, of course, recognizes the problem and appears willing to enact those changes needed to promote the more efficient use of our defense industrial base. The House Armed Services Committee explained this in a report in which they recommended $6.2 billion more for the defense budget than President Carter had requested. The report stated that, "Over the past several years, the Committee has focused on the tendency of the Department of Defense to procure weapons systems in quantities that permit no economies of scale. Very often, the systems procured in low quantities are the systems for which there is an urgent need to meet an existing threat. The Committee has endeavored to convince the Department of Defense that this procurement policy is self-defeating. Such a policy not only delays the achievement of needed military capability for years, but today's 'savings' are inevitably offset by higher unit costs and cost penalties that must be paid in future years."

Congress thus understands the problem. It also perceives that despite the legitimate efforts of the best procurement experts, no acquisition policy has been able to mitigate against the steady increase in the cost of major weapon systems. The Committee thus describes a condition that is one of the results of our national method of appropriating and authorizing defense acquisition funds. The problem is, of course, curable provided that the military can justify to Congress multi-year funding by providing programmatic safeguards which will guarantee that equipment will be deployed in time and in the quantity planned.

These safeguards, it would seem to us, can be made available to Congress by the Department of Defense by maintaining a workable balance between efficient production rates, technological growth, reliability, and quantity relationships. In this regard, recourse to the conventional wisdom of industrial dynamics may provide more insight into the problem than an attempt to restructure the acquisition process as it is formally defined by regulation and military custom. Put another way, because of economic and military factors, the time may have come to reorder the priorities of the acquisition process to a more narrowly defined base centrally concerned with the least-cost production of rapidly deployable military equipment.